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NATIONAL DAM SAFETY PROGRAM, LAKE KALMIA DAM (NJ00166), DELAWAR--ETC(U)
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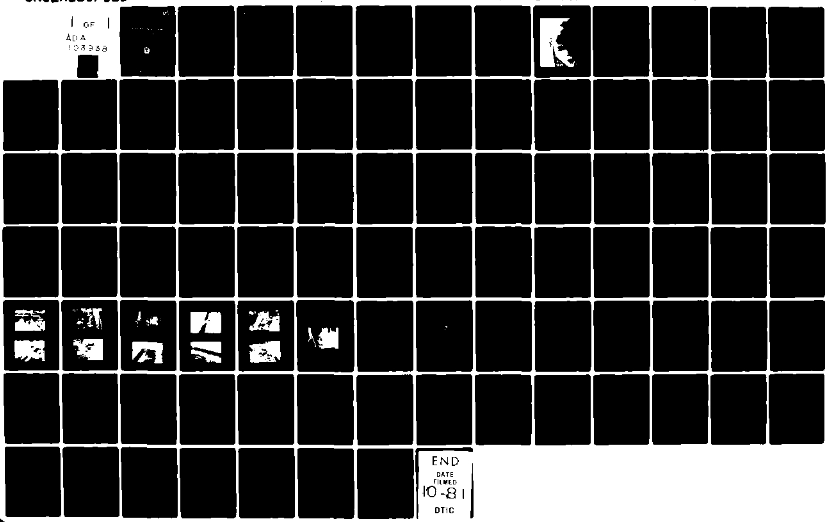

AD A103938

DELAWARE RIVER BASIN
TRIBUTARY TO PAULINS KILL,
WARREN COUNTY
NEW JERSEY

LAKE KALMIA DAM
NJ 00166

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

REPT. NO: DAEN/NAP-53842/NJ00166-81/08

AUGUST 1981

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER DAEN/NAP-53842/NJ00166-81/08	2. GOVT ACCESSION NO. AD A103 938	3. RECIPIENT'S CATALOG NUMBER
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		6. PERFORMING ORG. REPORT NUMBER
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9. PERFORMING ORGANIZATION NAME AND ADDRESS Anderson-Nichols 150 Causeway St. Boston, MA 02114		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
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16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

Warren A.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams	National Dam Safety Program
Embankments	Lake Kalmia Dam, N.J.
Visual Inspection	Erosion
Structural Analysis	Seepage
	Spillways

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
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IN REPLY REFER TO
NAPEN-N

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

31 AUG 1981

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Lake Kalmia Dam in Warren County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Lake Kalmia Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in poor overall condition. Also, the dam's spillway is considered inadequate since 2 percent of the 100 year flood would overtop the dam. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. For the same reasons no further studies or increase of spillway capacity are recommended. To assure continued functioning of the dam and its impoundment, the following actions could be undertaken by the owner:

a. Repair the depression and cracking of the concrete slab on the dam crest.

b. Remove trees and their root systems from the crest and downstream slope of the dam.

c. Take action to correct potential erosion and undermining of the downstream toe of the dam caused by the flow of water from seepage near the right abutment.

d. Take action to correct seepage and wet, soft areas along the downstream toe of the spillway.

NAPEN-N
Honorable Brendan T. Byrne

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

Roger L. Baldwin

Incl
As stated

ROGER L. BALDWIN
Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

LAKE KALMIA DAM (NJ00166)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 22 April 1981 by Anderson-Nichols and Co. Inc., under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Lake Kalmia Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in poor overall condition. Also, the dam's spillway is considered inadequate since 2 percent of the 100 year flood would overtop the dam. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. For the same reasons no further studies or increase of spillway capacity are recommended. To assure continued functioning of the dam and its impoundment, the following actions could be undertaken by the owner:

a. Repair the depression and cracking of the concrete slab on the dam crest.

b. Remove trees and their root systems from the crest and downstream slope of the dam.

c. Take action to correct potential erosion and undermining of the downstream toe of the dam caused by the flow of water from seepage near the right abutment.

d. Take action to correct seepage and wet, soft areas along the downstream toe of the spillway.

APPROVED: Roger L Baldwin

ROGER L. BALDWIN
Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

DATE: 31 Aug 81

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Lake Kalmia
Identification No.:	Fed ID No. NJ00166
State Located:	New Jersey
County Located:	Warren
Stream:	Tributary to Paulins Kill
River Basin:	Delaware
Date of Inspection	April 22, 1981

ASSESSMENT OF GENERAL CONDITIONS

Lake Kalmia Dam is 52 years old and in poor condition. It is small in size and should be downgraded to low hazard from its initial classification of high hazard. It is a 346-foot long earthen embankment with a concrete upstream face along most of its length. The dam has a hydraulic height of 6.6 feet. Its spillway is a broadcrested 4.3-foot wide weir passing flow through a flume 0.8-foot deep and 39.5 feet long across the dam crest. The low-level outlet is a valved 8-inch CIP. The soft, wet areas and seepage at the downstream toe of the dam near the right abutment are indicative of seepage through or under the dam. Trees growing on the dam crest and downstream slope and brush which eventually attains tree size may cause seepage and erosion problems. The flow of water along a portion of the toe of the dam from the seep near the right abutment could erode the toe of the embankment which could contribute to stability problems. Erosion and further deterioration of the downstream vertical, concrete-faced masonry wall (probably remnants of the original spillway) could contribute to stability problems, if not controlled. Cracks and spalling of the upstream, vertical concrete wall, if not repaired, could also contribute to stability problems. The depression and cracking of the concrete slab on the dam crest near the upstream face and left of the spillway flume may be indicative of internal erosion and should be corrected. The spillway capacity of 9.2 cfs at top of dam is 1.9 percent of the routed 100-year spillway design flood peak discharge of 487 cfs, and it is considered inadequate.

Lake Kalmia Dam does not now pose a potential hazard to loss of life and only minimal property damage could occur if it should be breached. However, should the owner wish to maintain the integrity of the embankment he should retain the services of a professional engineer, qualified in the design and construction of dams to accomplish the following in the near future: Investigate the cause of the depression and cracking of the concrete slab on the dam crest and design and oversee required corrective measures; design and oversee procedures for the removal of trees and their root systems from the crest and downstream slope of the dam; evaluate the potential for

erosion and undermining of the downstream toe of the dam caused by the flow of water from seepage near the right abutment; investigate the cause of seepage and wet, soft areas along the downstream toe of the spillway and design remedial measures; design or specify repairs for the vertical, concrete-faced masonry wall at the end of the spillway apron and to the right and left of the spillway; design and oversee the repairs to the deteriorated concrete wall on the upstream face; design and oversee repairs to restore the low-level outlet to operable condition; and investigate the adequacy of the spillway capacity and design and oversee remedial measures as needed.

It is further recommended that the owner accomplish the following tasks as a part of operating and maintenance procedures. In the near future: art a program of periodically checking the condi the dam and monitoring the wet area along the toe of ream slope; remove trees and brush for a distance downstream from the toe of the dam; clear trees and ither side of the spillway discharge channel for a d e of 100 feet from the spillway crest or to the property line whichever is the lesser; develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

ANDERSON-NICHOLS & COMPANY, INC.

Warren A. Guinan

Warren A. Guinan, P.E.
Project Manager
New Jersey No. 16848

April 22, 1981

LAKE KALMIA DAM
OVERVIEW PHOTO

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C., 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonable possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION PROGRAM
LAKE KALMIA DAM
FED ID NO. #NJ00166

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Authority to perform the Phase I Safety Inspection of Lake Kalmia Dam was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 12 December 1980 under Basic Contract No. FPM-39, and Contract No. A01093 dated 10 October 1979. This Authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the U.S. Army Engineers District, Philadelphia. The inspection discussed herein was performed by Anderson-Nichols & Company, Inc.

b. Purpose. The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to the safety of Lake Kalmia Dam and appurtenances. Conclusions are based upon available data and visual inspection. The results of this study are used to determine any need for emergency measures and to conclude if additional studies, investigations, and analyses are necessary and warranted.

1.2 Project Description

a. Description of Dam and Appurtenances. Lake Kalmia Dam is a 346-foot long earth embankment with a concrete upstream face along most of its length. It has a hydraulic height of 6.6 feet, and a structural height of 7.5 feet. The embankment's width varies from 16 to 80 feet. The principal spillway is a 4.3 foot long broad-crested weir, about 0.8 feet below the low point of the dam. The 244-foot long concrete portion of the upstream slope is vertical. The rest of the upstream face and the downstream face vary in slope. Early plans show an 8-inch outlet pipe. The valve for this pipe is on the dam crest, but the outlet may not be in operating condition. About 400 feet east of the dam's left (east) abutment, a natural saddle would serve to carry some flow at high stages as an emergency spillway.

CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY REPORT

LAKE KALMIA DAM FED ID NO. NJ00166

b. Location. The dam is located in Blairstown Township, Warren County, New Jersey on a tributary of Paulins Kill. The dam is at 40° 59.6' north latitude and 74° 58.0' west longitude on the Blairstown Quadrangle. The dam can be reached by taking State Route 521 North (Exit 12 off Interstate 80) for about 6 miles, to Mill Brook Road. The dam is approximately one mile down Mill Brook Road on the left hand side. A location map has been included as Figure 3.

c. Size Classification. Lake Kalmia Dam is classified as being small in size on the basis of storage at the dam crest of 92.8 acre-feet, which is less than 1000 acre-feet but more than 50 acre-feet, and on the basis of its structural height of 7.5 feet, which is less than 40 feet, in accordance with criteria given in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. The only structures along the stream downstream of Lake Kalmia Dam are the frame buildings of the old Girl Scout headquarters and seasonal cabins associated with a camp. The structures have been unoccupied for about 5 years and are scheduled to be torn down. Accordingly the hazard classification for this dam is low.

e. Ownership. Lake Kalmia Dam is owned by the Girl Scouts of Essex County, 120 Valley Road, Montclair, New Jersey 07042. The dam's caretaker, Art Hoehny, can be reached at (717) 828-2970.

f. Purpose. Lake Kalmia Dam was built for recreational purposes.

g. Design and Construction History. The dam was originally built in 1929. A plan and elevation of Lake Kalmia Dam entitled "Proposed Dam Reinforcement - Lake Kalmia - Blairstown, N.J., Mr. E. O. Ogur, Consulting Engineer, Newark, N.J." was available in the NJDEP files. The date on this plan is illegible, but believed to be dated October 25, 1935. Rebuilding was accomplished in 1936.

h. Normal Operational Procedure. No operational procedures for the dam were disclosed.

i. Site Geology. No site specific geologic information (such as borings) was available at the time the dam was inspected. Information derived from the Geological Map of New Jersey (Kummel and Johnson, 1912) indicates soils consist of till overlying bedrock.

The depth to bedrock at the dam site is unknown and outcrops were not observed during the dam inspection. The previous mentioned map indicates that bedrock in this area consists of massive to thin bedded limestone of Cambrian to Ordovician age. Based on information contained in New Jersey Department of Environmental Protection files, the area downstream contains sink holes (probably in the limestones).

1.3 Pertinent Data

a. Drainage Area

0.50 square miles (NJDEP records indicate 0.6 square miles).

b. Discharge at Damsite (cfs)

Maximum flood at damsite - unknown; caretaker indicates that dam was overtopped by 4 inches in the spring of 1981.

Total ungated spillway capacity at maximum pool elevation 411.1 (at top of dam) - 9.2.

c. Elevation (ft. above NGVD)

Top of dam - 411.1

Test flood surcharge (100-year storm) - 411.85

Recreational pool (at time of inspection) - 410.0

Spillway crest - 410.3

Streambed at centerline of spillway - 404.5

Maximum tailwater - 405.3 (estimated)

d. Reservoir (feet)

Length of maximum pool - 1200 (estimated)

Spillway crest - 1100 (estimated)

e. Storage (acre-feet)

Spillway crest - 77.0

Test flood surcharge (100-year storm) - 108

Top of dam - 92.8

f. Reservoir Surface (acres)

Top of dam - 20.3 (estimated)

Spillway crest - 19.2 (estimated)

g. Dam

Type - earthfill with concrete upstream face

Length - 346 feet

Height - 6.6 feet (hydraulic)

- 7.5 feet (structural)

Top Width - Varies from 16 to 80 feet

Side slopes - Upstream varies, vertical for much of its length; downstream varies

Zoning - unknown

Impervious core - unknown

Cutoff - unknown

Grout curtain - unknown

h. Spillway

Type - Broad-crested concrete spillway flume 39.5 feet in length

Length of weir - 4.3 feet

Crest elevation - 410.3' NGVD

Low level outlet - 8-inch valved CIP - may not be operable

U/S Channel - Lake Kalmia

D/S Channel - Small unnamed stream (this stream drains into a sink hole; no culvert is present under road 0.2 mile downstream of dam).

SECTION 2
ENGINEERING DATA

2.1 Design

No hydraulic, hydrologic, or other design engineering data were disclosed. The design plans for rebuilding the dam (1935) on file at NJDEP were in basic agreement with field observations.

2.2 Construction

Only correspondence concerning original construction of the Lake Kalmia Dam were disclosed. The rebuilding plan and profile (1935) was recovered from NJDEP files.

2.3 Operation

No data pertaining to the operation of the dam were found.

2.4 Evaluation

a. Availability. A search of the New Jersey Department of Environmental Protection files, and contact with community officials revealed a limited amount of information. All disclosed information was retrieved and is contained in Appendix 1.

b. Adequacy. The plans, supplemented by visual inspection, are deemed adequate to complete this Phase I inspection.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. Dam. Trees are growing on the crest of the dam, on the downstream slope, and in the area at the downstream toe of the dam. Cracked and spalled concrete was evident at several locations along the upstream vertical concrete wall.

Some seepage is discharging at the toe of the dam near the contact with the right abutment. The seepage is clear with no evidence of suspended fines. This seepage flows along the downstream toe until it reaches a large wet swampy area to the right of the spillway channel. The area at the downstream toe is generally wet and soft for its entire length, and contains extensive wetland vegetation.

A partially deteriorated concrete faced masonry stone wall, approximately 2 to 3 ft. high, was exposed to the right and left of the spillway for a distance of approximately 20 to 40 ft. The concrete faced wall grades into a series of large stones and boulders which have been placed along the toe.

A depression was observed in the crest of dam near the upstream face adjacent to the left side of the spillway flume. The concrete slab covering the crest is cracked and settled in this area.

b. Appurtenant Structures. Erosion has occurred on the downstream slope of the embankment adjacent to both spillway wingwalls. Extensive erosion has developed at the vertical masonry and concrete wall at the end of the spillway flume which was partially obscured owing to water flowing from the spillway flume during the site visit. The low-level outlet and gate valve were not visible at the time of inspection. (The outlet is reported to be an 8-inch CIP.) A vertical 12-inch CMP pipe stand on the dam crest apparently houses the valve stem.

c. Reservoir Area. The watershed above the lake is gently to moderately sloping and wooded. The reservoir slopes appear to be stable. No evidence of significant sedimentation was observed.

d. Downstream Channel. The channel downstream from the spillway is poorly defined and meanders past the large swampy area downstream from the dam. Some trees are growing on the banks of the channel downstream of the spillway. As no culvert could be found under the road 0.2 miles downstream, channel discharges may as yet be draining into the old sink hole mentioned in Section 1.2.h.

SECTION 4
OPERATIONAL PROCEDURES

4.1 <u>Procedures</u>

No formal operating procedures were revealed.

4.2 Maintenance of Dam

No formal maintenance procedures for the dam were found.

4.3 Maintenance of Operating Facilities

No formal maintenance procedures for the operating facilities were discovered.

4.4 Warning System

No description of any warning system was found.

4.5 Evaluation of Operational Adequacy

Because of the lack of operation and maintenance procedures, the remedial measures described in Section 7.2 should be implemented as described.

SECTION 5
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. Design Data. Because no original hydrologic/hydraulic design data were revealed, an evaluation of such data could not be performed.

b. Experience Data. No experience data were found. The caretaker, by phone, recently stated that the dam was overtopped by 4 inches in the spring of 1981 (probably subsequent to the site inspection).

c. Visual Inspection. The spillway for Lake Kalmia Dam consists of a 4.3 foot long concrete broad-crested weir discharging into a 39.5 foot long by 0.8 foot deep flume. No visual evidence was found of damage to the structure caused by overtopping. At the time of inspection, approximately 0.1 foot of water was flowing over the spillway crest.

d. Lake Kalmia Dam Overtopping Potential. The hydraulic/ hydrologic evaluation for the dam is based on a selected Spillway Design Flood (SDF) equal to the 100-year flood in accordance with the range of test floods given in the evaluation guidelines, for dams classified as low hazard and small in size. The 100-year flood was determined by applying the 100-year 2-hour rainfall hyetograph to the SCS dimensionless unit hydrograph for the drainage area. Hydrologic computation are given in Appendices 4 and 5. The peak 100-year outflow from Lake Kalmia is 487 cfs.

The minimum elevation of the dam allows 0.8 foot of flow over the spillway crest before overtopping occurs. Under this head the spillway capacity is 9.2 cfs, which is about 1.9 percent of the selected SDF. Thus the spillway capacity is inadequate.

Under test flood conditions the natural saddle 400 feet east of the dam, which might serve as an emergency spillway would convey 96 cfs, with 26 cfs going over the spillway and 372 cfs over the dam crest. The elevation of the natural saddle is higher than the dam crest, so it does not increase project capacity at the top of the dam.

e. Drawdown. If the 8-inch cast iron pipe shown on the plans for Lake Kalmia Dam could be operated, it would draw Lake Kalmia down in 15 days assuming no inflow. This is considered marginal for draining the reservoir under emergency conditions; but adequate, considering the small drainage area.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

The soft, wet area and seepage at the downstream toe of the dam near the right abutment are indicative of seepage either through or under the dam which, if not properly controlled, could lead to failure of the dam by piping or sloughing of the downstream slope. The flow of water along a portion of the toe of the dam from the seep near the right abutment could erode the toe of the embankment which would contribute to stability problems. Trees growing on the crest and downstream slope and brush which eventually attain tree size may cause seepage and erosion problems. This is especially true if a tree blows over and pulls out its roots, or if a tree dies or is cut and its roots rot. Erosion and further deterioration of the downstream, vertical, concrete-faced masonry wall (probably remnants of the original spillway) could contribute to stability problems in the embankment, if not properly controlled. Cracks and spalling of the upstream, vertical, concrete wall, if not repaired, could also contribute to stability problems.

The depression and cracking of the concrete slab on the dam crest near the upstream face and left side of the spillway flume may be indicative of internal erosion and should be corrected.

6.2 Design and Construction Data

No design or construcion data pertinent to the structural stability of the dam are available.

6.3 Operating Records

No operating records pertinent to the structural stability of the dam are available.

6.4 Post-Construction Changes

A plan showing the rebuilding, accomplished in 1936, shows the upstream concrete wall and spillway to be as noted in the inspection (See Appendix 1). State of New Jersey records (see also Appendix 1) reflect that the saddle, 400 feet left of the dam, contained a second concrete spillway that would have been the principal spillway as its invert was one-half foot lower than that of the flume spillway at the dam. No evidence of the concrete work in this area was observed.

6.5 <u>Seismic Stability</u>. This dam is in Seismic Zone 1. According to the Recommended Guidelines, dams located in Seismic Zone 1 "may be assumed to present no hazard from earthquake, provided static stability conditions are satisfied and conventional safety margins exist." None of the visual observations made during the inspection are conclusively indicative of unstable slopes. However, because no data are available concerning the engineering properties of the embankment and foundation materials for this dam, or the condition of the base of the dam, it is not possible to make an engineering evaluation of the stability of the slopes or the factor of safety under static conditions.

SECTION 7
ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Lake Kalmia Dam is 52 years old and is in poor condition.

b. Adequacy of Information. The information available is such that the assessment of the dam must be based primarily on the results of the visual inspection.

c. Urgency. Because the dam poses no hazard to life and little hazard to property there is little urgency to implement the recommendations in Section 7.2 based on safety considerations. Should the owner wish to maintain the dam embankment the recommendations should be implemented as prescribed.

d. Necessity for Additional Data/Evaluation. The information available from the visual inspection is adequate to identify the potential problems which are listed in 7.2.a. These problems require the attention of a professional engineer who will have to make additional engineering studies to design or specify remedial measures to rectify the problems. If left unattended, the problems could lead to failure of the dam.

7.2 Recommendatons/Remedial Measures

a. Recommendations. The owner should retain a professional engineer qualified in the design and construction of dams to accomplish the following in the near future:

(1) Investigate the cause of the depression and cracking of the concrete slab on the dam crest and design and oversee required corrective measures.

(2) Design and oversee procedures for the removal of trees and their root systems from the crest and downstream slope of the dam.

(3) Evaluate the potential for erosion and undermining of the downstream toe of the dam caused by the flow of water from seepage near the right abutment.

(4) Investigate the cause of seepage and wet, soft areas along the downstream toe of the spillway and design remedial measures.

(5) Design or specify repairs for the vertical, concrete-faced masonry wall at the end of the spillway apron and to the right and left of the spillway.

(6) Design and oversee the repairs to the deteriorated concrete wall on the upstream face.

(7) Design and oversee repairs to restore the low-level outlet to operable condition.

(8) Investigate the adequacy of the spillway capacity and design and oversee remedial measures as needed.

b. Alternatives. If the recreational aspects of this dam and reservoir are considered essential, no alternative is recommended; however, if considered non-essential, the dam could be breached and the reservoir returned to the Lake Kalmia original state of a small springfed lake.

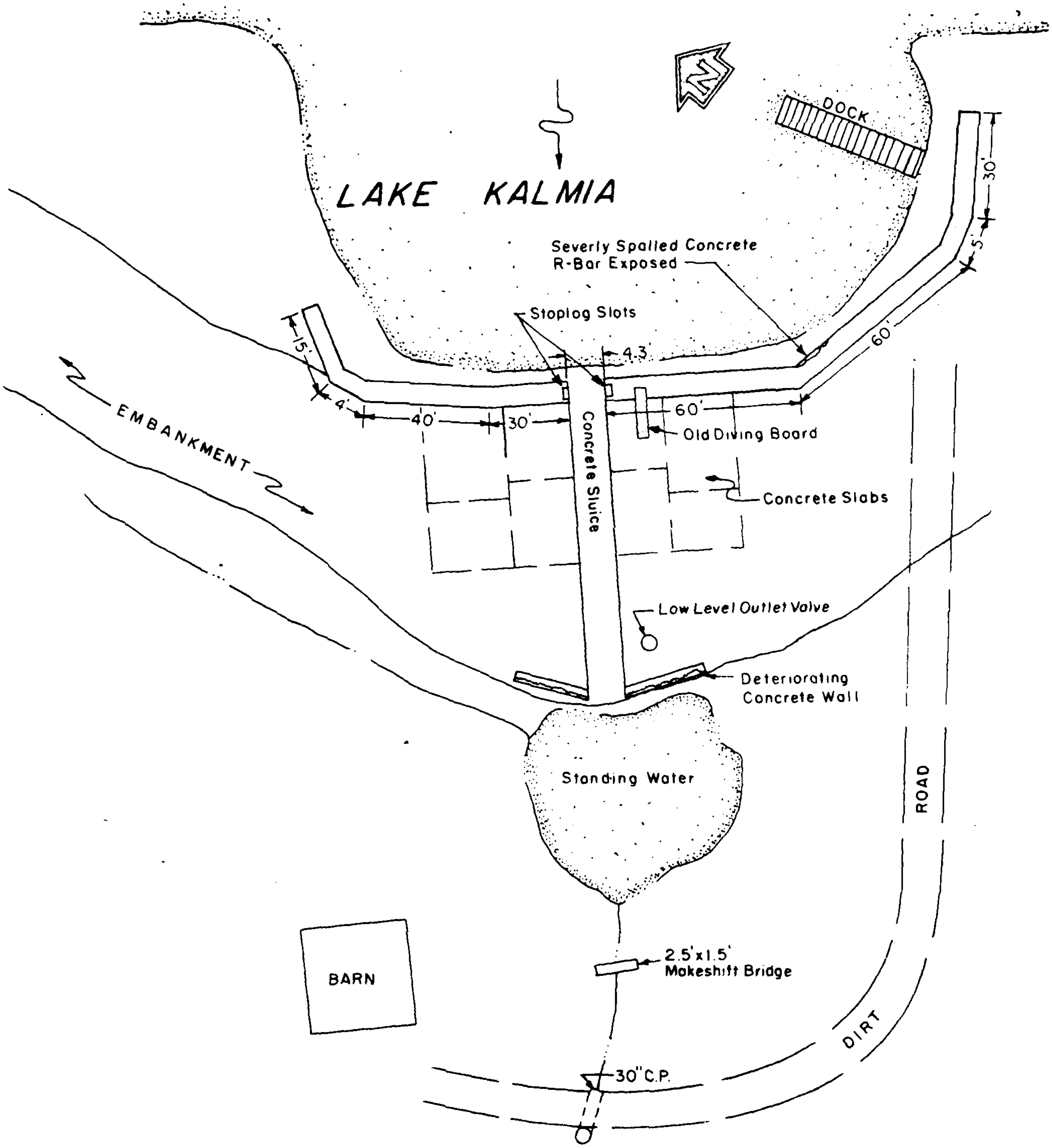
c. Operating and Maintenance Procedures. The owner should accomplish the following items in the near future:

(1) Start a program of periodically checking the condition of the dam and monitoring the wet area along the toe of the downstream slope.

(2) Remove trees and brush for a distance of 25 feet downstream from the toe of the dam or to the property line whichever is less.

(3) Clear trees and brush on either side of the spillway discharge channel for a distance of 100 feet from the spillway crest or to the property line whichever is less.

(4) Develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.



Anderson-Nichols & Co., Inc BOSTON MASSACHUSETTS	U.S. ARMY ENGINEER DIST PHILADELPHIA CORPS OF ENGINEERS PHILADELPHIA, PA

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

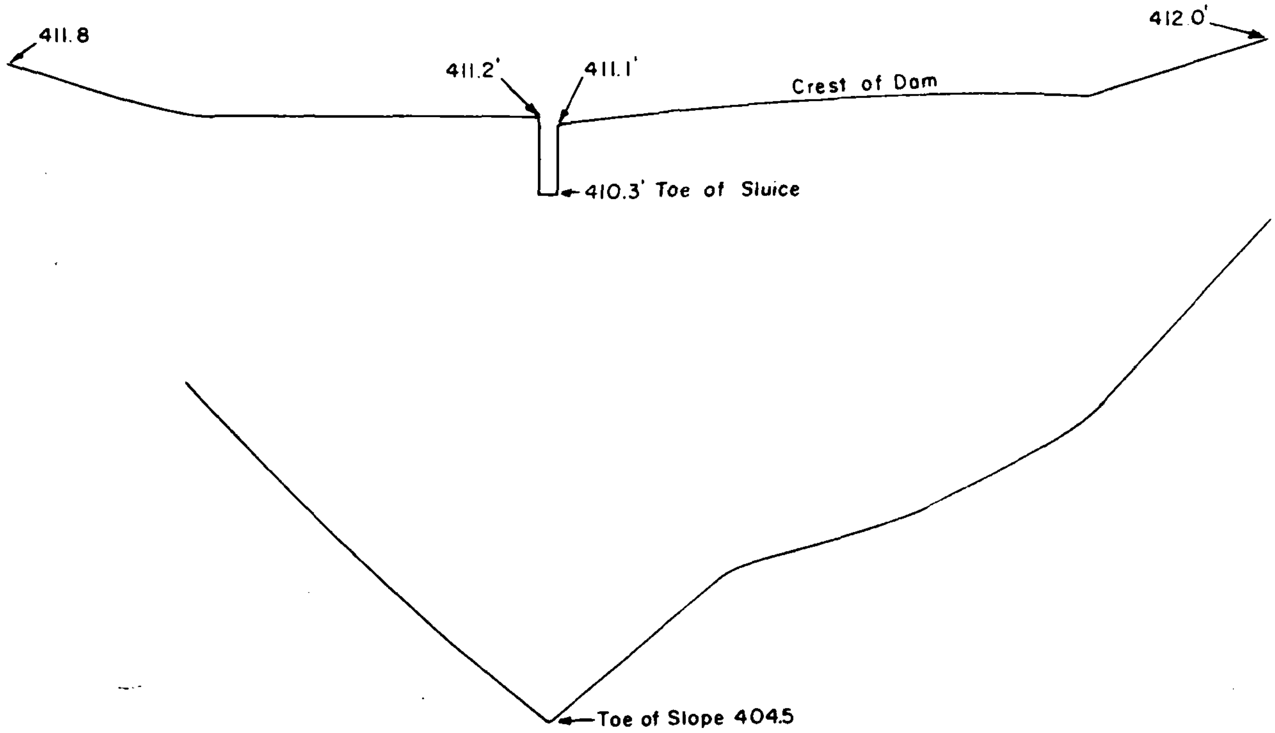
LAKE KALMIA DAM
PLAN

TRIB. TO PAULINS KILL — NEW JERSEY

SCALE NOT TO SCALE

DATE

FIGURE - 1



Anderson-Nichols & Co., Inc. BOSTON MASSACHUSETTS	U.S. ARMY ENGINEER DIST. PHILADELPHIA CORPS OF ENGINEERS PHILADELPHIA, PA

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LAKE KALMIA DAM ELEVATION

TRIB. TO PAULINS KILL NEW JERSEY

SCALE: NOT TO SCALE

DATE:

FIGURE -

Anderson-Nichols & Co., Inc.
BOSTON MASSACHUSETTS

U.S. ARMY ENGINEER DIST. PHILADELPHIA
CORPS OF ENGINEERS
PHILADELPHIA, PA.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LAKE KALMIA DAM
LOCATION MAP

TRIB. TO PAULINS KILL — NEW JERSEY

SCALE: 1" = 4 Miles Approx.
DATE:

SCALE IN MILES
0 4 8

MAP BASED ON STATE OF NEW JERSEY OFFICIAL MAP & GUIDE.

APPENDIX 1

ENGINEERING DATA

LAKE KALMIA DAM

PAULINSKILL

DAMS IN NEW JERSEY—REFERENCE DATA

NO. 21-30

Name of Owner Newark Girl Scouts Address 901 Broad Street, Newark, N. J.

Name of Dam Lake Kalmia County Warren Location 21.43.1.3.8

CONSTRUCTION: Date Rebuilt 1935-36 By whom Lorenz-Hassee, Inc. 336 Stuyvesant Ave. Irvington, N.J.

Stream Small Branch Tributary to Paulinskill

DRAINAGE BASIN: Area 0.15 sq. mi. Description Rolling, 1/2 wooded.

Description of valley below dam Meadow

DAMAGE FROM FAILURE: Probable None

Previous (date) —

Purpose Recreation Type Earth embankment, reinforced concrete wall upstream

Foundation —

Length 240 ft. Max. height 10 ft. Max. width of base 1.0 ft.

Upstream slope Vertical Downstream slope 1:1 Volume — Cu. yds.

SPILLWAY: Type Concrete notches Length Total 28 ft.

Depth below top of dam 2' and 1.5' ft. Capacity 500 c. f. s. per sq. mi.

RESERVOIR: Capacity — mill. gals. Area — acres. Length — ft.

Outlets 1 - 8" C.I. Pipe with gate valve in manhole.

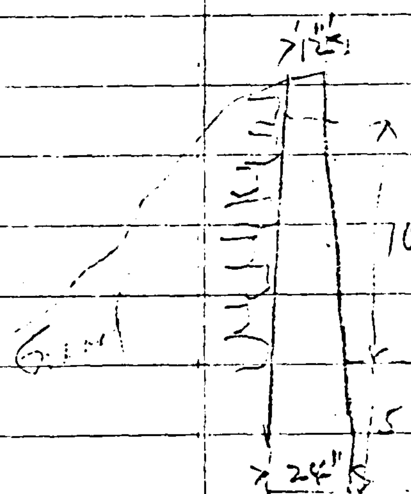
Remarks *Spillway #1 Concrete trough on dam fill 4' x 1.5' deep.
Spillway #2 Concrete notch in saddle 300' left of dam [illegible]
[illegible] = 3.0 1.0' freeboard.

Sources of data Inspection and drawing filed 10/31/35 Date 11/1/35

10/31/35
HJC
D

Dam near Blairstown -
on very small Brook. - Property
~~p~~ planned - with concrete wall
Newark Girl Scout Council

Mrs. Von Vorice   901 Broad St.
Newark



E. Ogur   446 N Grove St
E. Orange

P. G. Haase of
Ferry-Haase Inc
336 Stuyvesant Ave
Irvington N.J.

Essex 3-6118

Warren Co
Newark Girl Scout Dam
Dam # 21-20
Frelinghuysen

October 31, 1935.

Mr. P. G. Haase,
336 Stuyvesant Avenue,
Irvington, N. J.

Dear Sir:

With regard to the repair of the Newark Girl Scout dam at Lake Kalmir near Blairstown, New Jersey, I wish to advise that after conversation with Mr. John Quigley, game warden residing in Blairstown, we were able to confirm your statement that this lake is spring fed and is not on a stream of any size. Under the circumstances, no formal permit is necessary from this Commission to repair the structure in accordance with the drawings prepared by E. Ogur, Consulting Engineer, Newark, dated October 25, 1935.

We are returning herewith the specification, but are retaining the drawing for our files.

Yours very truly,

H. T. Critchlow
Division Engineer.

Report on Dam Inspection

NEWARK GIRL SCOUT DAM

Dam No. 21 - 30.

Location 21.43.1.3.8.

At the request of Mr. Edward L. Lanterman, Engineer, inspection of this dam was made on January 14, 1930 in company with Mr. Lanterman.

Since the inspection of October 15, 1929 additional fill has been made on the top and the downstream slope of the dam, erosion of the earth fill has been stopped and a concrete notch spillway has been built in a natural saddle 500 feet to left of dam.

The additional fill on downstream slope of dam should be completed to the left end of embankment reducing the slope from 1 to 1 to about 1-1/2 to 1.

The spillway consists of a concrete wall with its top at the same elevation as the top of the dam and two openings each 2 feet deep and 12 feet long. With 1 foot freeboard the spillway capacity is 400 sec. ft. per sq. mi. and with the top of dam awash 1130 sec. ft. per sq. mi. From the spillway notch a small ditch has been dug around the back of the knoll to a limestone sink hole in the meadow below the dam. This sink hole is reported to have taken the stream flow before the dam was built. The ditch appears too small to carry the maximum spillway discharge but overflow from it will probably be infrequent and no damage is likely to be done by the overflow spreading out on the meadow below. A pile of clay which lies across the upstream side of the spillway should be removed.

Water in the pond stood 2 feet below the spillway crest.

The spillway capacity is sufficient to care for the probable maximum flood flow and the slopes of the earth embankment, though steeper than usually approved by the Commission's engineers are considered sufficient in view of the clay of which the banks are made and the absence of apparent damage should the dam fail by slumping of the embankment.

When the above mentioned work has been done, namely the completion of the additional fill on downstream slope and removal of clay bank in front of spillway, the dam may be considered satisfactory.

John N. Brooks

Trenton, N. J.,
January 15, 1930.

John N. Brooks,
Assistant Division Engineer.

Copy to Mr Hamilton

COMMISSIONERS
WILLARD I. HAMILTON, CHAIRMAN
NEWARK
F. MORSE ARCHER
CAMDEN
CORNELIUS DOREMUS
RIDGEWOOD
MAX GROSSMAN
ATLANTIC CITY
THURLOW G. NELSON
HIGHLAND PARK
HENRY G. PARKER
NEW BRUNSWICK
OWEN J. PRIOR
TRENTON

MORRIS R. SHERRERD
CHIEF ENGINEER

GEORGE S. BURGESS
SECRETARY
605 BROAD STREET
NEWARK, N. J.

STATE OF NEW JERSEY
STATE WATER POLICY COMMISSION

December 31, 1929.

RECEIVED
JAN 2 1930
STATE WATER POLIC
COMMISSION

Mr. H. T. Critchlow, Division Engineer,
State Water Policy Commission,
Trenton, N. J.

Dear Mr. Critchlow:

In reply to yours of the 30th, enclosing copy of letter written to Mr. Lanterman, I quite agree with the practice followed, and since I am interested in the Girl Scouts organization, authorized the above to apply for the inspection merely in order to see that proper report of the completion of the work was made.

The precautions taken at my direction when the new dam was built represented a substantially greater margin of safety than required by law. One of Mr. Brooks' inspections was rendered necessary because he failed to get in touch with Mr. Lanterman as had been suggested, and either went alone or, as was rumored, perhaps inaccurately, with a contractor who had failed to secure some work. The net result was that he gained an erroneous impression, which was later corrected.

Yours sincerely,

Chairman.

Trenton Office. December 30, 1929.

Mr. Willard I. Hamilton, Chairman
State Water Policy Commission,
605 Broad Street,
Newark, N. J.

Dear Mr. Hamilton:-

I am enclosing for your information copy of my letter of even date herewith, to Mr. Edward L. Lanterman, in regard to inspection of the Newark Girl Scout dam near Blairstown.

This dam was inspected twice during last summer, and I am satisfied that it is in satisfactory condition for the winter. I doubt if any satisfactory inspection could be made at the present time.

Yours very truly,

H. T. Critchlow,
Division Engineer

JNB:MHB

File dams - ~~Sussex~~ Co.
Warren

RECEIVED
NOV 14 1929
STATE WATER POLICY
COMMISSION

Blairstown Nov 13 1929

Mr John Burke
Dear Mr Burke

Mr J. M. Croupe contractor is now putting the stone on the Dam known as the Newark Girl scouts at Blairstown nearly finished I wish you would drop around and look it over so we can finish it up to your satisfaction

Sincerely
Edward L. [illegible]

P.S. If you have a chance to let me know when you will be up I will be glad to see you

RECEIVED
SEP 28 1929
STATE WATER POLICY
COMMISSION

Edward L. Lanterman
Blairstown New Jersey

Mr John N. Brooks,
Hydraulic Engineer,
State Water Policy Commission,
State House Annex,
Trenton N.J

September 26-1929

Dear Mr Brooks:

The improvements at the Newark Girl Scouts' Camp at Blairstown, N.J started in November, 1928.
Since receiving your letter I have made a survey of the water shed at the lake and find the same to be about One hundred acres
There was no intention whatever of with holding an application for permission to build the Dam at the Girl Scouts' Camp, if it were necessary.
If you think it necessary, We can file an application now and send you the details, keep, etc. but before doing so, think you should meet me on the property and make a Complete inspection with me. You will recall my Earlier invitation to do so when we met at Mountain Lake at Mr Folkner's finished dam.

However, I have been informed that you did inspect the site of the new Dam with some one Else, Perhaps you were not aware of the provision we are making for an overflow or Spillway at another part of the Lake.
You will be interested to know that my instruction from the Trustees of the Camp were to make the Core wall so strong as to be beyond the possibility of Criticism. The width of the base and of the Core and the strenth of the mixture are Evidence of this fact.
The Core is two feet wide at the base and tapers to one foot at the top
If you still think a formal application is necessary, Please advise me when you can meet me in Blairstown,

Yours very truly,
Edward L. Lauterman

RECEIVED

SEP 10 1929

STATE WATER POLICY COMMISSION

Blairstown Sept 9-1929

Mr John W. Burks

Dear Sir:

Your letter of the 6th received as to the question you ask I have forward your letter to Mr Willard I Hamilton of Newark to answer same. The Dam is not finished yet, and any suggestions you may make or offer in any way will be gladly received and I will mail them to Mr Hamilton. Awaiting your reply

I remain Yours truly
Edward L. Lauterman

PS Sorry I did not see you while you was here

Report on Dam Inspection.

NEWARK GIRL SCOUTS

Dam No. 21-30

Location 21.43.1.3.8.

This dam was built during the spring of 1929 under the direction of Mr. Edward L. Lanterman of Blairstown, without permit.

The structure is an earth dam with concrete core wall, 250 feet long and with a maximum ~~pipe~~ height of 11 feet ~~long~~. The top width is 6 feet and the side slope 1;1.

The fill has been made of gravel without compacting and has been badly washed at the left end by flood water from a nearby road. The fill shows marked settlement throughout the length of the dam.

There is ~~16~~ 1-8 inch cast iron blow-off pipe with gate valve ~~and~~ in manhole.

The dam has no spillway.

The water shed measures on the map 0.6 square mile. However, the small stream on which this dam has been placed formerly lost itself in a meadow below the dam site and there is no Culvert beneath the highway 0.2 mile below the dam.

It does not appear probably that the dam will ever be overtopped.

There was no water in the pond.

John N. Brooks.

Trenton, N.J.,
September 6, 1929.

John N. Brooks,
Hydraulic Engineer.

Dams - Warren Co

Trenton Office. September 6th, 1929.

Mr. Ed. L. Lanterman,
Blairstown, N. J.

Dear Mr. Lanterman:-

We made an inspection this morning of the dam which you built for the Newark Girl Scouts about 1-1/2 mile northwest of Blairstown.

The drainage area tributary on this dam as measured on the State map is 0.6 square mile and the dam is 11 feet high.

Therefore, under the old law which was in force at the time this dam was built you should have made application to the proper State Authority for approval of your plans.

You will kindly be so good as to inform this office why the dam was built without the approval of plans

Yours very truly,

STATE WATER POLICY COMMISSION.

John N. Brooks,
Hydraulic Engineer.

JNB:MHB

RECE VED
AUG 5 1929
STATE WAT POLIC
COMMISSION

Blairstown Aug 2d 1929

AUG 5 1929
JWB

Mr John W Brooke

Dear Sir

Your letter of July 31st received

I have marked on the enclosed Map you sent me the Place where the Girls Scouts of Newark have built a new Dam, This Place is simply a Spring run feeding this place for the Girls to Swim in This Spring run emptied into a Sink Hole just below the Dam and then disappeared Any time you come up will show it to you

As to the Springdale Alterations that Mr N. H. Hart owns there I do not know what he intends to do As he has never told me I have asked him several times but no diffinate reply I will see him up again shortly then I will write [illegible] as soon as I can get

Something Tanagiable to write You
That place would make a fine Lake
if he decides to go ahead with it —
Yours truly
Edward L. Latimer

Did Mr Folkner write You any thing
in regard to a Spring run he proposes to
Dam up to make a Fish Pond with Dirt
Just South of Mountain Lake formerly Greens Pond
I think he better build a Concrete Core Dam
as he has a Large Water Shed behind him
When he writes You, I will leave it all to Your
Judgement to tell him what to expect

APPENDIX 2

CHECK LIST

VISUAL INSPECTION

LAKE KALMIA DAM

Check List
Visual Inspection
Phase 1

Name Dam Lake Kalmia County Warren State NJ(00166) Coordinators NJDEP

Date(s) Inspection 2/18/81, 4/22/81 Weather Warm, Sunny; Clear Temperature 40°, 65°

Pool Elevation at Time of Inspection 410.3'+ NGVD Tailwater at Time of Inspection 405' NGVD

Inspection Personnel:

K. Stuart — W. Guinan

D. Deane — S. Gilman

R. Murdock

F.D.Deane/S.Gilman/R.Murdock Recorder

Ms. Marjorie Vance, representing the Girl Scouts of Essex County, was present during the April inspection.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	U/s face of dam is badly spalled and cracked. One section near right end is eroded in a "V" form approximately 8" deep - Reinforcing bars are showing. Concrete slabs on top are cracked and disjointed. Stop log slots approximately 1 foot downstream from inlet.	Repair deteriorated, cracked spalled concrete.
APPROACH CHANNEL	Clear and unobstructed;	
DISCHARGE CHANNEL	D/s face is eroded and spalled. D/s concrete masonry walls on either side of spillway channel are badly spalled and cracked. Trash and other debris at toe of spillway, including channel drain. Extensive vegetation, trees & debris, downstream from spillway apron. Drop-off chute spillway severely eroded.	Repair deteriorated concrete. Remove trash and debris. Clear vegetation.
BRIDGE AND PIERS OVER SPILLWAY		

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Erosion and sloughing on downstream slope. Trees up to 14 inches in diameter on slope.	Under qualified supervision, remove the trees and their roots.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Good	
RIPRAP FAILURES	No rip-rap.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
RAILINGS	None	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Erosion of both sides of spillway structure.	Repair eroded area.
ANY NOTICEABLE SEEPAGE	Seepage at toe of slope near junction with right abutment. Majority of area at toe of slope is wet and soggy.	Investigate seepage and correct problem.
STAFF GAGE AND RECORDER	None observed.	
DRAINS	None observed.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Could not observe either end of conduit.	
INTAKE STRUCTURE	Not observable.	
OUTLET PIPE	Not observed - d/s end covered with debris.	Clear debris.
OUTLET CHANNEL	Well-defined flat slope through open area with a few trees (cedar).	
EMERGENCY GATE	CMP access to valve filled with trash. Last operation unknown. Could not determine valve size.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gradual to moderately sloped, wooded and some open fields.	
SEDIMENTATION	No noticeable sedimentation was observed.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Trash and debris at spillway drop-off.	(See description of ungated spillway channel)
SLOPES	Flat	
APPROXIMATE NO. OF HOMES AND POPULATION	Three old former camp cabins to be razed - no occupants.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	None found. Information is available on the Proposed Dam Reinforcement Plan on file at the New Jersey Department of Environmental Protection, Prospect Street, Trenton, New Jersey 08625
REGIONAL VICINITY MAP	Prepared for this report
CONSTRUCTION HISTORY	Some information available in NJDEP files. Legible sheets are included in Appendix 1, ENGINEERING AND EXPERIENCE DATA.
TYPICAL SECTIONS OF DAM	Available from plan mentioned above
HYDROLOGIC/HYDRAULIC DATA	None found
OUTLETS - PLAN	None found
- DETAILS	8" C.I. Pipe with gate valve in manhole
- CONSTRAINTS	None found
- DISCHARGE RATINGS	None found
RAINFALL/RESERVOIR RECORDS	None found

ITEM	REMARKS
DESIGN REPORTS	None found
GEOLOGY REPORTS	None found
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None found
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None found
POST-CONSTRUCTION SURVEYS OF DAM	See PLAN OF DAM on previous page
BORROW SOURCES	Unknown

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	Reinforcement. See PLAN OF DAM
HIGH POOL RECORDS	None found
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Some information available in NJDEP files. Legible sheets are includeded in Appendix 1, ENGINEERING AND EXPERIENCE DATA.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Unknown
MAINTENANCE OPERATION RECORDS	None found

ITEMS	REMARKS
SPILLWAY PLAN	None found
SECTIONS	
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	None found

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 0.50 square miles fields and woods (50 percent each)

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 410.3' NGVD (77 ac-ft)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY: Not applicable

ELEVATION MAXIMUM TEST FLOOD POOL: 411.8' NGVD

ELEVATION TOP DAM: 411.1' NGVD (92.8 acre-feet)

SPILLWAY CREST: Broad-crested

a. Elevation 410.3' NGVD upstream invert

b. Type Rectangular Flume

c. Width 4.3 feet (flume)

d. Length 39.5 feet (flume)

e. Location Spillover Center of dam

f. Number and Type of Gates None (stop log slots present)

OUTLET WORKS: One 8-inch pipe with valve (may not be operable)

a. Type Presumed to be cast iron pipe

b. Location Just left (east) of spillway

c. Entrance Invert 404' NGVD (estimated)

d. Exit Inverts 404' NGVD (estimated)

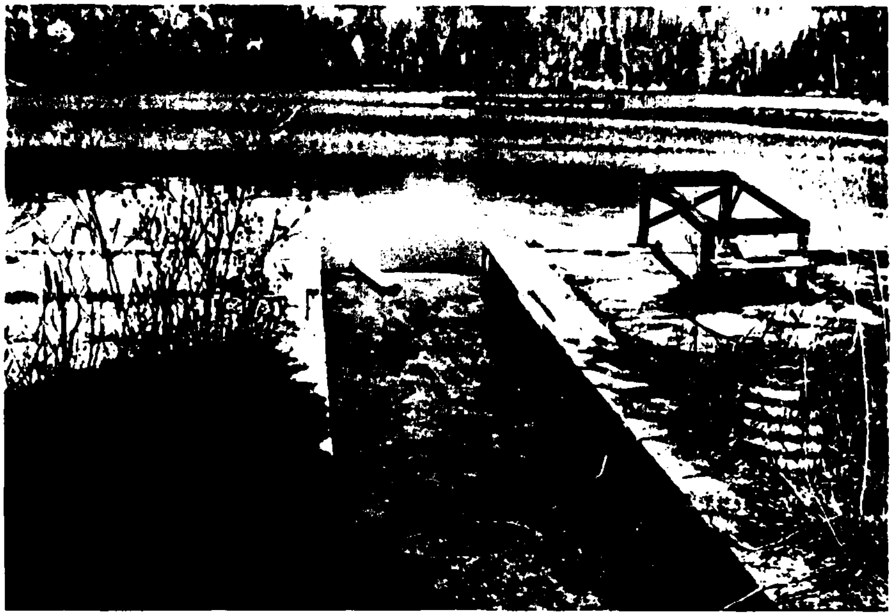
HYDROMETEOROLOGICAL GAGES: None

MAXIMUM NON-DAMAGING DISCHARGE: 9.2 cfs

APPENDIX 3

PHOTOGRAPHS

LAKE KALMIA DAM



April 22, 1981

Dam crest, note settlement and cracking of concrete adjacent to iron diving platform.

April 22, 1981

Downstream spillway channel below spillway apron.

April 22, 1981

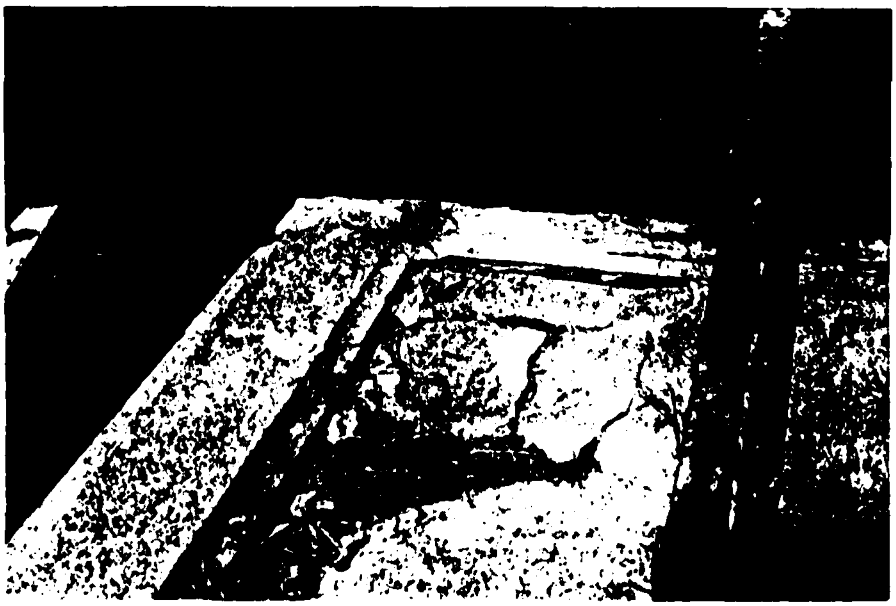
Downstream end of spillway - note vertical drop of water.

February 18, 1981

Spillway exit - note debris at dropoff. The end is beginning to get undermined.

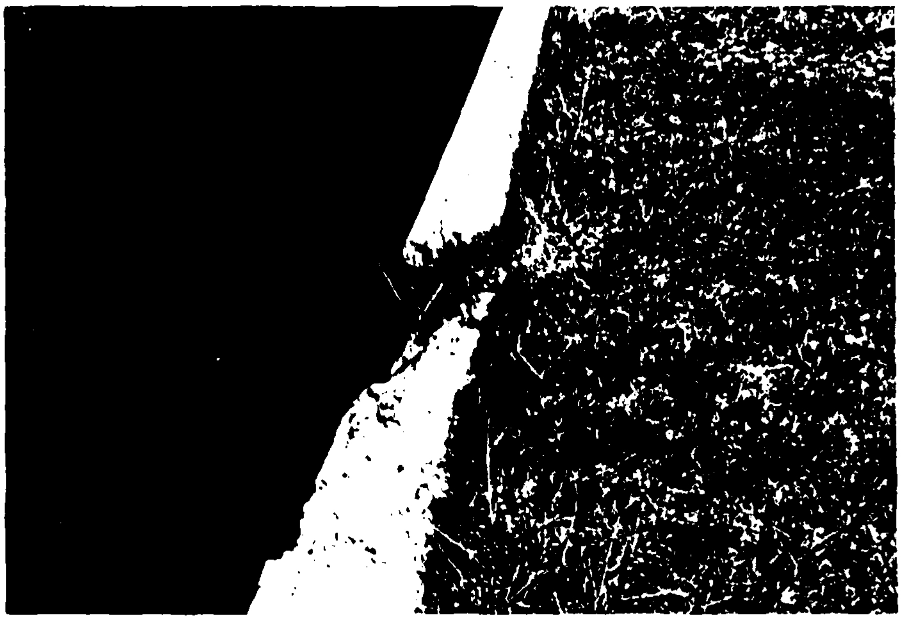
April 21, 19[illegible]

Saddle about 400 feet east of dam that probably would serve as emergency spillway. Looking at upstream face from west side of bay.



April 22, 1981

Settlement and cracked area under slab at spillway inlet at left training wall near diving board frame. Note training walls notched for stoplog.



April 22, 1981

Spalled concrete upstream wall in first dogleg to left of spillway.

April 22, 1981

Spalled concrete upstream wall.

April 22, 1981

Erosion and deterioration of masonry wall at downstream face of dam, right (west) of spillway.

April 22, 1981

Erosion adjacent to left spillway wall.

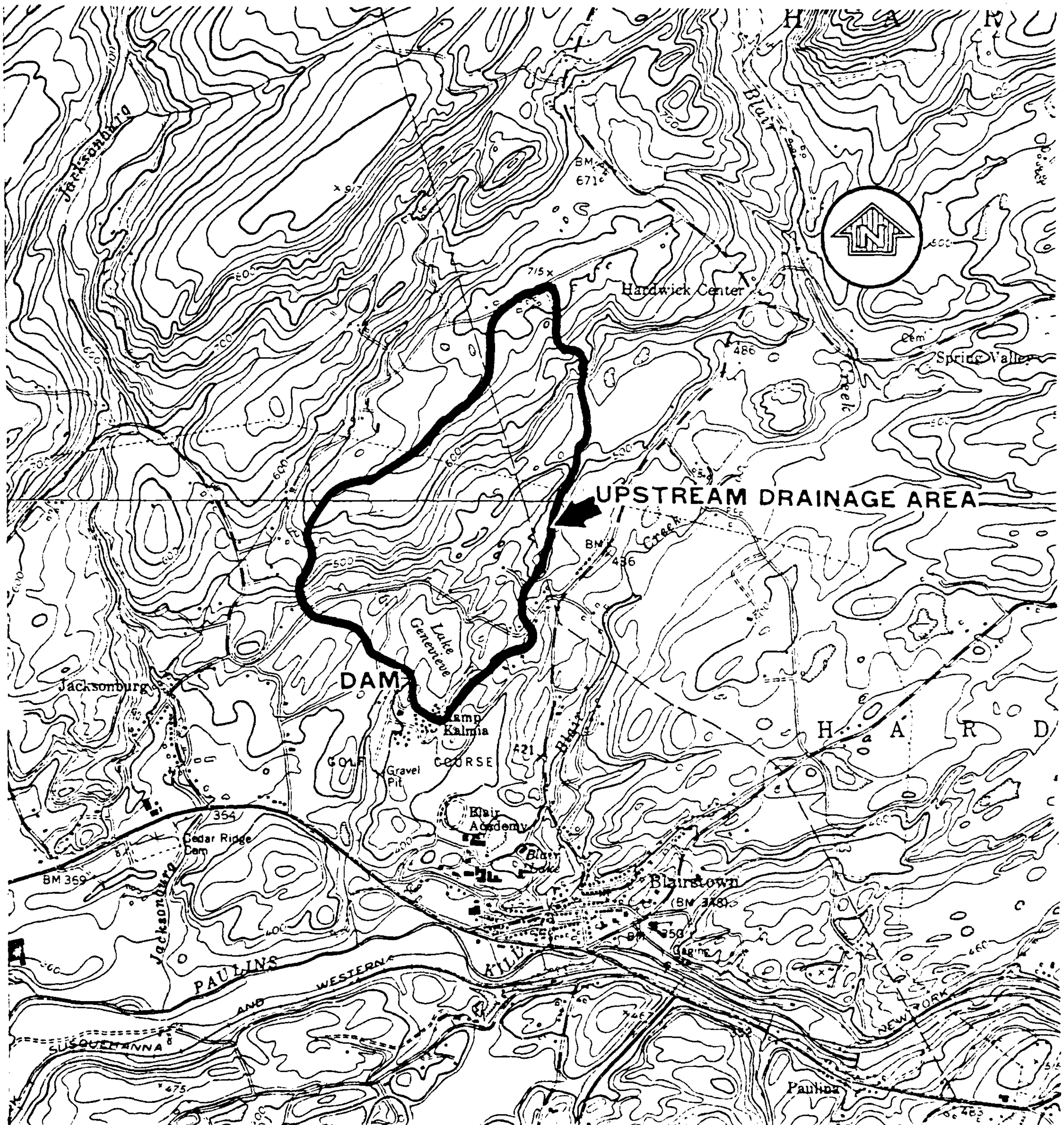
April 22, 19[illegible]

Toe of slope, near right abutment. Seepage appears to flow from location directly across from end of upstream vertical concrete face.

APPENDIX 4

HYDROLOGIC COMPUTATIONS

LAKE KALMIA DAM



NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LAKE KALMIA DAM
BLAIRSTOWN TOWNSHIP, NEW JERSEY

REGIONAL VICINITY MAP

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

Anderson-Nichols & Company, Inc. BOSTON, MA.

SCALE IN MILES

0 1/2 1

MAP BASED ON U.S.G.S. 7.5 MINUTE QUADRANGLE SHEET FLATBROOKVILLE, N.J., PA. 1954, REVISED 1971, AND BLAIRSTOWN, N.J. 1954, REVISED 1971.

Anderson-Nichols & Company, Inc. Subject Lake Kalinia

Sheet No. 1 of 15
Date 6/25/81
Computed TCG
Checked CKP

JOB NO.

SQUARES 1/4 IN. SCALE

Time of Concentration

① Texas Highway Method

all overland, = 5,300 ft. slope = $\frac{715-410}{5,300} = 0.058 = 5.8\%$

From the Texas Highway method chart in Design of Small Dams, V = 2.0 fps for woodlands.

Time: $\frac{5,300}{2} = 2,650$ sec = 0.74 hours

② Soil and Water Conservation Method

$$L = 0.6\,T_c = \frac{\ell^{0.8}\,(s+1)^{1.67}}{9000\,y^{0.5}}$$

$$\rightarrow T_c = \frac{\ell^{0.8}\,(s+1)^{1.67}}{0.6\,(9000)\,y^{0.5}}$$

ℓ = 5,300 ft.

y = 5.8%

$s = \frac{1,000}{CN} - 10$ CN = 70 for woods of soil group C, good condition. $S = \frac{1000}{70} - 10 = 4.29$

$$T_c = \frac{5,300^{0.8}\,(5.29)^{1.67}}{0.6\,(9,000)\,(5.8)^{0.5}} = 1.18 \text{ hours}$$

③ Weston, or SCS T.R. #55 Method

all overland. slope = 5.8% → V = 0.6 fps

$T_c = \frac{5,300}{0.6} = 8,833$ sec = 2.45 hours

Anderson-Nichols & Company, Inc.

Subject Lake Kalmia

Sheet No. 2 of 15
Date 6/25/81
Computed TCG
Checked CRP

JOB NO.

SQUARES 1/4 IN. SCALE

④ Kerby Method

all overland.

$$T_c = 0.83 \left(\frac{N \ell}{\sqrt{S}} \right)^{0.467} \qquad N = 0.7;\ \ell = 5,300;\ S = 0.058$$

$$= 0.83 \left(\frac{0.7(5,300)}{\sqrt{0.058}} \right)^{0.467}$$

$$= 74.94 \text{ min} = 1.25 \text{ hours}$$

$$\text{Average} = \frac{0.74 + 1.18 + 2.45 + 1.25}{4} = 1.4 \text{ hours}$$

Lag = $0.6\,T_c$ = 0.84 hours

Drainage Area = 0.50 square miles

SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Stage Vs. Discharge

The hydraulic profile of Lake Kalmia is shown on P. 4.
See the profile for sections of dam crest, referred to as ①, ②, etc

Spillway (8) $Q = C L H^{3/2}$ $C = 3.0$ for Broad Crested concrete weir

$Q = 3.0\,(4.3)\,(E - 410.3)^{3/2}$

Top of Dam (sections 6, 7, 9, 10, 11, and 12) $C = 2.7$ for all sections

section 6 is a sloping weir 50' long, w/ one end at 411.2' and the other at 411.8' (411.5' avg.). The slope is $\frac{50}{0.6}$ = 83.3 H : 1V.

section 7 is a level 98' weir at 411.2'.

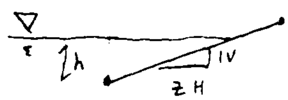
Section 9 is a sloping weir 47.7 feet long, with one end at 411.1' and the other at 411.3' (411.2' avg.) The slope is $\frac{47.7}{0.2}$ = 238.5H : 1V.

Section 10 is a sloping weir 50 feet long, with ends at 411.3' and 411.4' (avg. = 411.35). The slope is $\frac{50}{0.1}$ = 500H : 1V.

Section 11 is a 50' level weir at 411.4

Section 12 is a 50' sloping weir with ends at 411.4 and 412.0 (avg. = 411.7'). The slope is $\frac{50}{0.6}$ = 83.33 H : 1V

For a sloping weir only partially submerged:



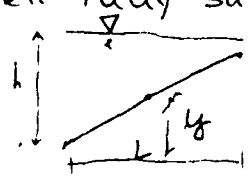
$$Q = C\,L_{sub}\,H_{avg.}^{3/2}$$

$$H_{avg} = \frac{0 + h}{2} = 0.5\,h$$

$$L_{sub} = z\,h$$

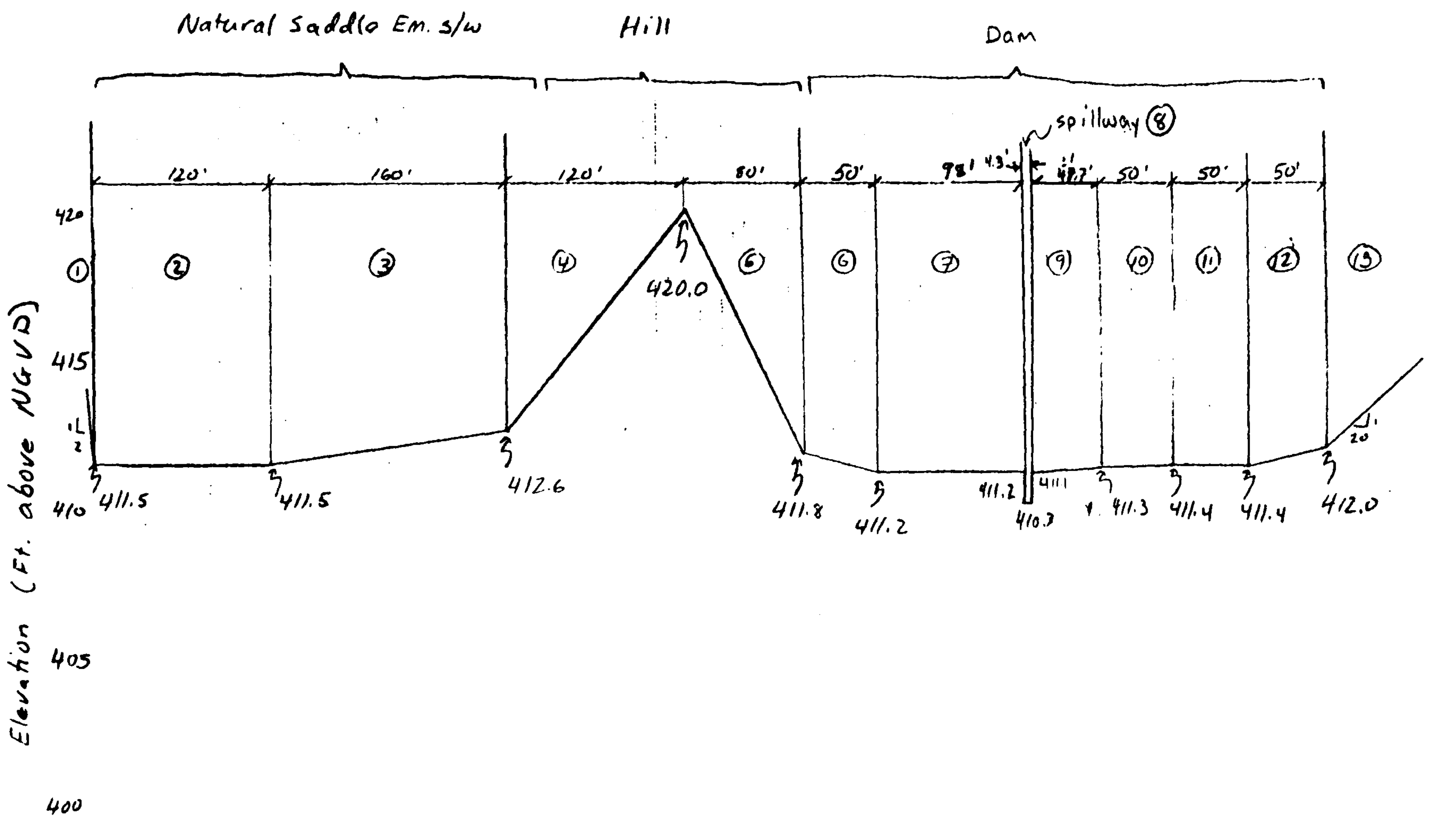
$$Q = C\,(z)(h)\,(0.5(h))^{3/2}$$

For a sloping weir fully submerged:



$$Q = C\,L_{sub}\,H_{avg}^{3/2}$$

$$= C\,L\,(h - y)^{3/2}$$



ANDERSON-NICHOLS

VERNON | BOSTON | CONCORD

Lake Kalmia Dam
Hydraulic Profile

DATE	SCALE	JOB NO.	SHEET NO.
6/25/81	1" = 5' V 1" = 40' H	3670-08	P. 4 of 15

Anderson-Nichols & Company, Inc. Subject *Lake Kalmia*

Sheet No. 5 of 15
Date 6/26/81
Computed TCG
Checked CICT

JOB NO.

UARES IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

We will compute Q at 410.3, 410.7, 411.1, 411.5, 412.0, 412.5, 413.0, 413.5

at 410.3, 410.7, and 411.1 - no flow

at 411.5: $Q_6 = 2.7\ (83.3)\ (E-411.2)\ (0.5(E-411.2))^{3/2}$

$Q_7 = 2.7\ (98.)(E-411.2)^{3/2}$

$Q_9 = 2.7\ (47.7)(E-411.2)^{3/2}$

$Q_{10} = 2.7\ (50)\ (E-411.35)^{3/2}$

$Q_{11} = 2.7\ (50)\ (E-411.4)^{3/2}$

$Q_{12} = 2.7\ (83.3)(E-411.4)\ (0.5\ (E-411.4))^{3/2}$

$Q = Q_6 + Q_7 + Q_9 + Q_{10} + Q_{11} + Q_{12}$

at 412.0, 412.5, 413.0, and 413.5

$Q_6 = 2.7\ (50)(E-411.5)^{3/2}$

$Q_{12} = 2.7\ (50)(E-411.7)^{3/2}$

Q_7, Q_9, Q_{10}, Q_{11} the same as at 411.5

<u>Natural Saddle</u> (sections 1, 2, 3, 4) . C: 2.6 for all sections

Section 1 is a 2H : 1V sloping weir with its low end at 411.5'

Section 2 is an even crested 120 foot weir at 411.5'

Section 3 is a 145.5 H to 1V weir 160 feet long, with one end at 411.5 and the other at 412.6'

Section 4 is a 16.2 H : 1V sloping weir 120 feet long, with one end at 412.6' and the other at 420.0'.

at 410.3, 410.7, 411.1, 411.5 - no flow

at 412.0 and 412.5 : $Q_1 = 2.6\ (2)\ (E-411.5)\ (0.5\ (E-411.5))^{3/2}$

$Q_2 = 2.6\ (120)(E-411.5)^{3/2}$

$Q_3 = 2.6\ (145.5)(E-411.5)\ (0.5(E-411.5))^{3/2}$

Q_4 = no flow

$Q = Q_1 + Q_2 + Q_3 + Q_4$

SQUARES 1/4 IN. SCALE

at 413.0 and 413.5 : $Q_3 = 2.6(160)(E-412.05)^{3/2}$

$Q_4 = 2.6(16.2)(E\ 412.6)(0.5(E-412.6))^{3/2}$

Q_1 and Q_2 the same as before

<u>Side slopes:</u> (sections 5 and 13), C = 2.6

Section 5 is a 9.8 H:1V sloping weir, with one end at 411.8', the other at 420.0' and 415.9' average.
Section 13 is a 20H:1V sloping weir with its low end at 412.0

at 410.3, 410.7, 411.1, and 411.5: no flow

at 412.0, 412.5, 413.0, and 413.5: $Q_5 = 2.6\ (9.8)(E-411.8)(0.5(E-411.8))^{3/2}$

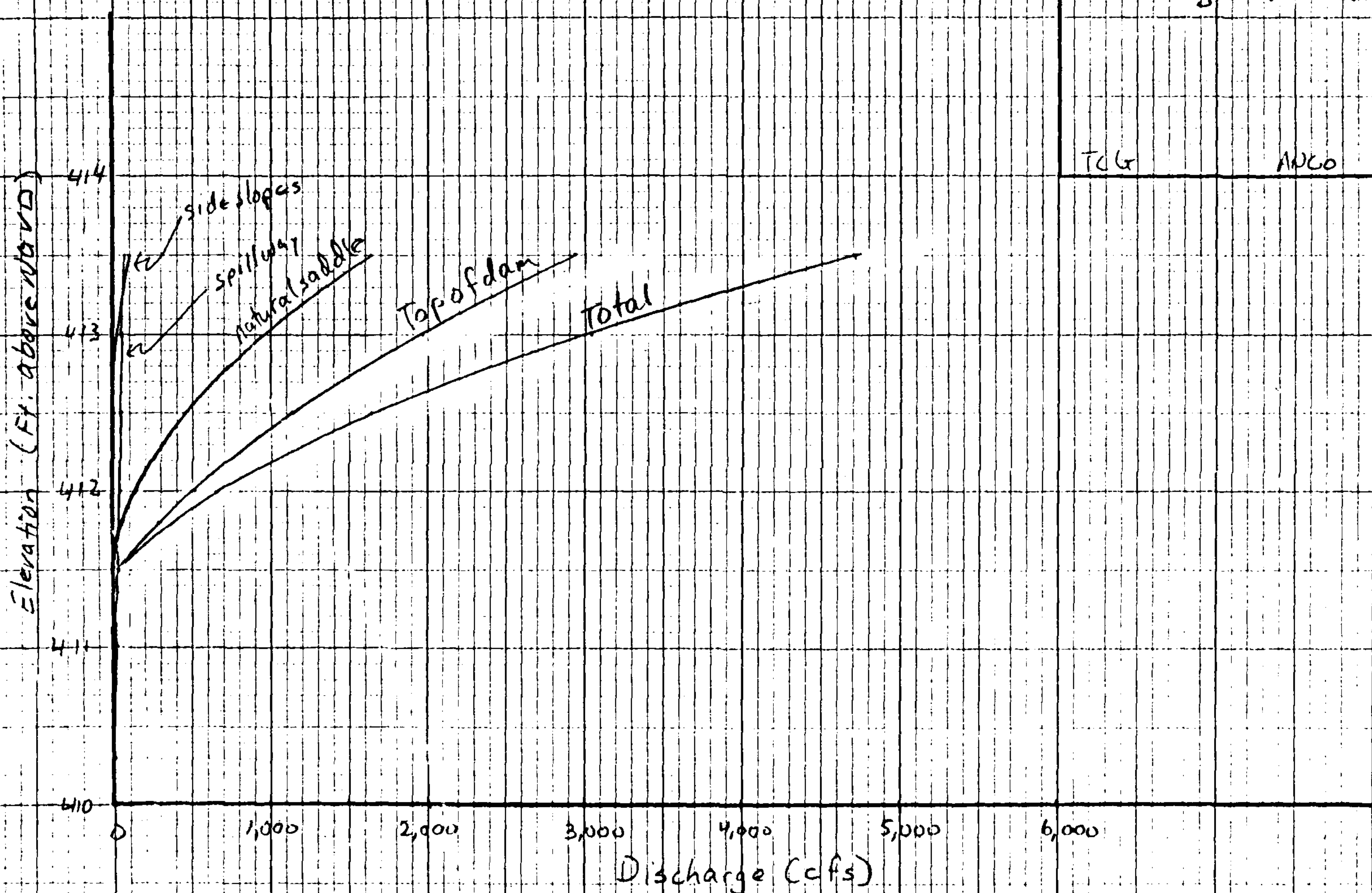
$Q_{13} = 2.6\ (20)(E-412.0)(0.5(E-412.0))^{3/2}$

Elevation (Ft. above NGVD)	$Q_{spillway}$ (cfs)	$Q_{Top\ of\ Dam}$ (cfs)	Q_{saddle} (cfs)	$Q_{side\ slopes}$ (cfs)	Q_{Total} (cfs)
410.3	0	0	0	0	0
410.7	3.3	0	0	0	3.3
411.1	9.2	0	0	0	9.2
411.5	17.0	81	0	0	98
412.0	29	485	134	0	648
412.5	42	1,137	448	7	1,634
413.0	57	1,957	965	33	3,012
413.5	74	2,917	1,631	85	4,707

Lake Kalmia Dam

Stage Versus Discharge

TCG ANCO 6/26/81



Anderson-Nichols & Company, Inc.

Subject Lake Kalmia

Date 6/26/81
Computed TCG
Checked KBS

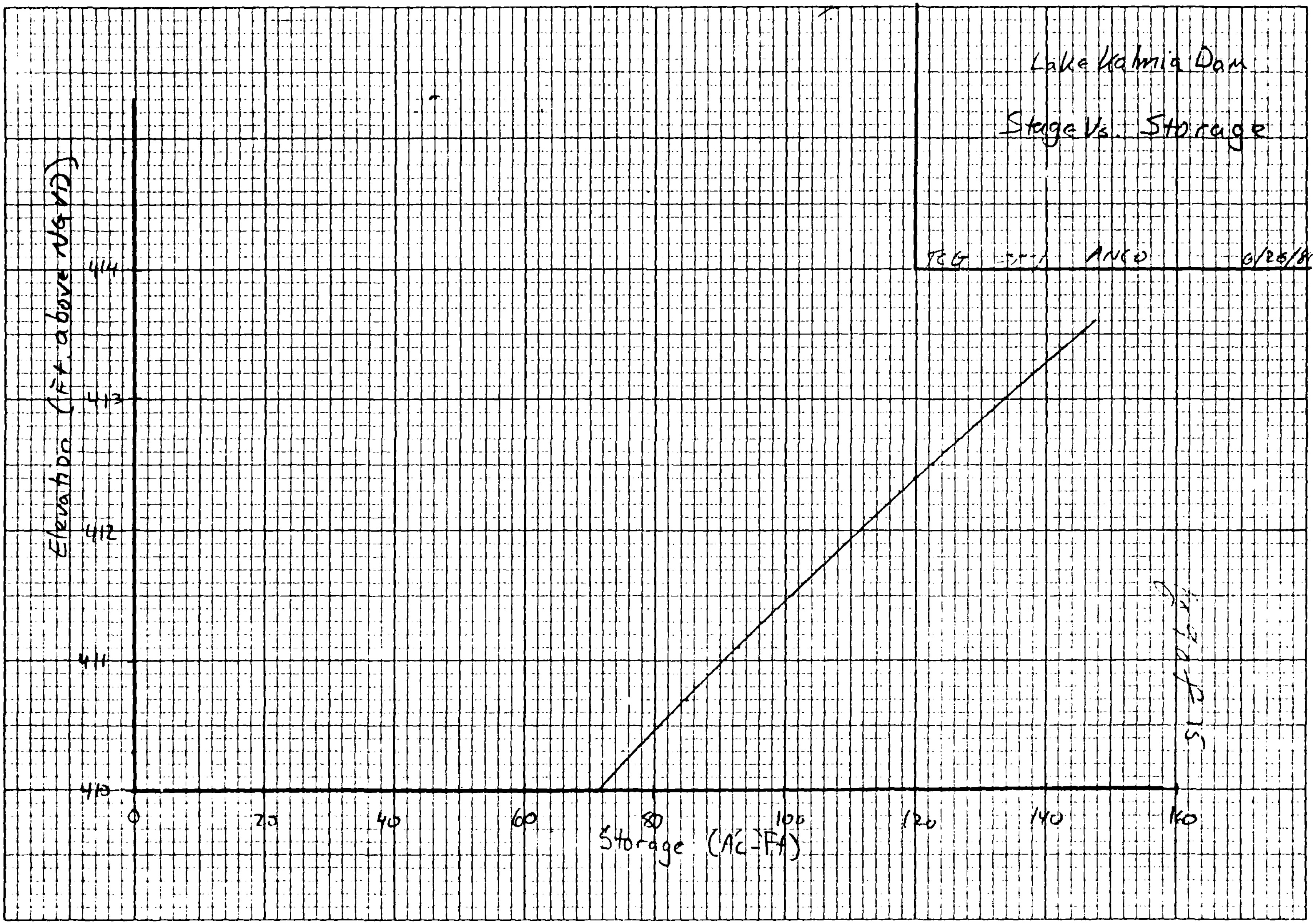
JOB NO.

SQUARES 1/4 IN. SCALE

Stage versus Storage

At the spillway crest, elevation 410.3, the pond has an area of 19.2 acres. At elevation 420, the surface area would be about 33 acres. Assume a linear increase in surface area with stage. Storage at the spillway crest = 77 ac-ft (avg depth = 4 ft.). Storage = 0 at 404.

Elevation (ft above NGVD)	ΔH	Surface Area (Acres)	Avg. S.A. (Acres)	Incremental Storage (Ac-Ft)	Cumulative Storage (Ac-Ft)
404.		-			0.0
	-		-	-	
410.3		19.2			77.0
	0.4		19.5	7.8	
410.7		19.8			84.8
	0.4		20.05	8.0	
411.1		20.3			92.8
	0.4		20.6	8.2	
411.5		20.9			101.0
	0.5		21.25	10.6	
412.0		21.6			111.6
	0.5		21.95	11.0	
412.5		22.3			122.6
	0.5		22.65	11.3	
413.0		23.0			133.9
	0.5		23.4	11.7	
413.5		23.8			145.6


Lake Kalmia Dam
Stage Vs. Storage
TCG
ANCO
6/26/81
Elevation (Ft. above NGVD)
414
413
412
411
410
0
20
40
60
80
100
120
140
160
Storage (Ac-Ft)

Rainfall - 100 year flood

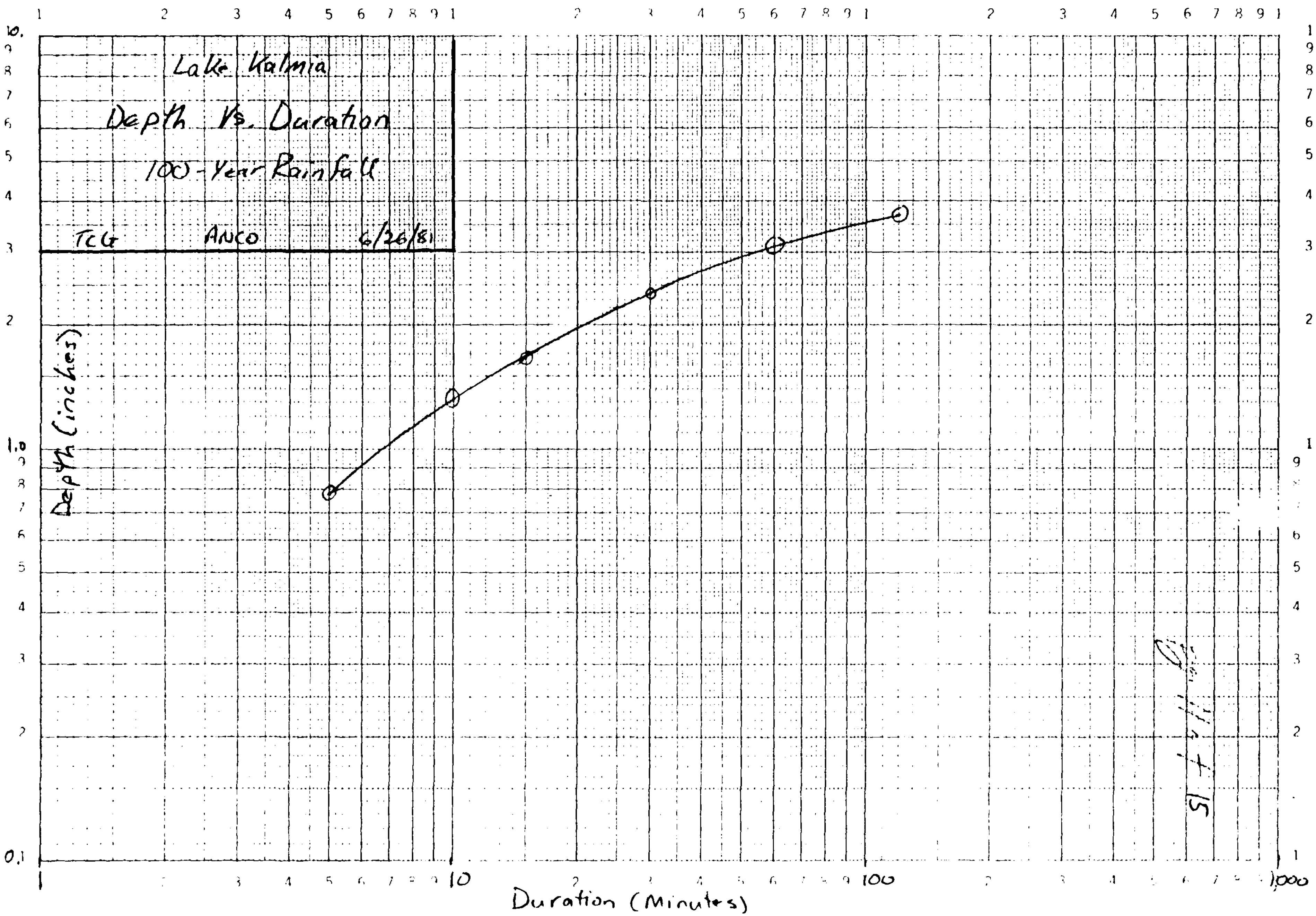
The 100-year flood is the test flood for this dam. For a T_c of 1.4 hours, we will use a 2-hour storm. (5 minute time steps). Use the "synthetic storm from depth-duration data", Hydro-35 NWS

Duration	100-year rainfall
5 minutes	0.78" [1]
10 "	$0.59 D_{15} + 0.41 D_5 = 1.31"$ [3]
15 "	1.68" [1]
30 "	$0.49 D_{60} + 0.51 D_{15} = 2.38"$ [3]
60 "	3.10" [1]
120 "	3.70" [2]

P.11 shows a mass curve for the peak 100 year depth versus duration for Lake Kalmia on Log-Log paper. The increments of rain are given on page 12. The storm will have the largest in the 13th time interval, 2nd largest in the 12th, 3rd largest in 14th, etc.

1. NWS Hydro-35
2. NWB TP-40
3. Interpolation from NWS Hydro 35

K+E LOGARITHMIC KEUFFEL & ESSER CO. 46 7320



11 of 15

Anderson-Nichols & Company, Inc.

Subject Lake Kalmia

Sheet No. 12 of 15
Date 6/26/81
Computed TCG
Checked KBS

JOB NO.

Duration (MIN)	Depth (IN.)	ΔT (Min.)	Δ Rain (in.)	Ranking	Time int.
0	0	5	0.78	1	13
5	0.78	5	0.53	2	12
10	1.31	5	0.37	3	14
15	1.68	5	0.29	4	11
20	1.97	5	0.22	5	15
25	2.19	5	0.19	6	10
30	2.38	5	0.18	7	16
35	2.56	5	0.14	8	9
40	2.70	5	0.10	9	17
45	2.80	5	0.10	10	8
50	2.90	5	0.10	11	18
55	3.00	5	0.10	12	7
60	3.10	5	.07	13	19
65	3.17	5	.06	14	6
70	3.23	5	.06	15	20
75	3.29	5	0.05	16	5
80	3.34	5	0.05	17	21
85	3.39	5	0.05	18	4
90	3.44	5	0.05	19	22
95	3.49	5	0.05	20	3
100	3.54	5	0.04	21	23
105	3.58	5	0.04	22	2
110	3.62	5	0.04	23	24
115	3.66	5	0.04	24	1
120	3.70				

So input incremental rainfall for 5 minute increments is 0.04, 0.04, 0.05, 0.05, 0.06, 0.06, 0.10, 0.10, 0.14, 0.19, 0.29, 0.53, 0.78, 0.37, 0.22, 0.18, 0.19 0.10, 0.07, 0.06, 0.05, 0.0.5, 0.04, 0.04

Anderson-Nichols & Company, Inc.

Subject Lake Kalmia

Sheet No. 13 of 15
Date 6/29/81
Computed TCG
Checked TCG

JOB NO.

SQUARES 1/4 IN. SCALE

Overtopping Analysis

For this small, low-hazard dam the 100 year storm was used to generate a test flood. The storm gives a peak outflow of 494 cfs, which is 54 times as large as the spillway capacity The peak 100-year stage would be 41.86 feet, 0.86 feet over the dam crest

At this stage, the flow is as follows

over spillway	=	26 cfs
over dam	=	372 cfs
Over natural saddle	=	96 cfs
Over side slopes	=	0.0 cfs
		494 cfs

Drawdown Time

The 8" pipe shown on the plans as a low-level outlet for Lake Kalmia may not be in operating condition. If it is, its invert is at about 404.0. Assume:

① no inflow

② inlet control on pipe. $Q = CA\sqrt{2g}\sqrt{H}$, $C = 0.61$, $A = \pi\left(\frac{1}{3}\right)^2 = 0.349\,ft^2$

$Q = 0.61(.349)(\sqrt{64.4})(E-404.33)^{1/2} = 1.71\,(E-404.33)^{\frac{1}{2}}$

③ storage follows the form $S = Ch^N$, $h = E-402$, given $S = 77$ at $h = 6.3$ and $S = 145.6$ at $h = 9.5$ (page 8):

$77 = C\,6.3^N$

$\ln 77 = \ln C + N \ln 6.3$

$\rightarrow \ln C = 4.344 - 1.841N$

and $145.6 = C\,9.5^N$

$\ln 145.6 = \ln C + N \ln 9.5$

substitute for $\ln C$

$\ln 145.6 = 4.344 - 1.841N + N \ln 11.5$

$4.981 - 4.344 = -1.841N + 2.251N$

$N = 1.554$

$\rightarrow \ln C = 4.344 - 2.116N = 1.483 \rightarrow C = 4.407$

so $S = 4.407\,(E-404)^{1.554}$

④ $Ac\text{-}Ft/day = Q_{AVG} \times 1.9835$

⑤ $Days = \dfrac{\Delta S}{Ac\text{-}Ft/day}$

Anderson-Nichols & Company, Inc.

Subject Kalmia Lake Dam

Sheet No. 15 of 15
Date 8/11/81
Computed CEF
Checked SM

JOB NO.

SQUARES 1/4 IN. SCALE

Elevation (ft above NVGD)	Storage (acre-ft)	ΔS (acre-ft)	Q (cfs)	Qave (cfs)	Ac-ft/day	DAYS
410.3	77		4.2			
		23.2		3.9	7.74	3.0
409	53.8		3.7			
		15.8		3.5	6.94	2.3
408	38.0		3.3			
		13.7		3.1	6.15	2.2
407	24.3		2.8			
		11.4		2.5	4.96	2.3
406	12.4		2.2			
		8.5		1.8	3.57	2.4
405	4.4		1.4			
		4.4		0.7	1.39	3.2
404	0		0			

15.4 days

APPENDIX 5

HEC1 OUTPUT

LAKE KALMIA DAM

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID     LAKE KALMIA DAM      OVERTOPPING ANALYSIS      TOM GOOCH    ANCO
  2           ID     NEW JERSEY DAM NO. 166 - WARREN COUNTY - BLAIRSTOWN TOWNSHIP
  3           ID     100-YEAR STORM (2-HOUR STORM)
  4           IT          5               0       200
  5           IO          2       1

  6           KK         41   LAKE KALMIA INFLOW HYDROGRAPH
  7           KM         INFLOW FROM SCS UNIT GRAPH COMPUTATIONS
  8           BA       0.50       0
  9           BF        1.5     1.5       1
 10           IN          5
 11           PG     INFLOW
 12           PI       0.04    0.04    0.05    0.05    0.05    0.06    0.10    0.10    0.14    0.19
 13           PI       0.29    0.53    0.78    0.37    0.22    0.18    0.10    0.10    0.10    0.06
 14           PI       0.05    0.05    0.04    0.04
 15           PR     INFLOW
 16           PW        1.0
 17           PT     INFLOW
 18           PW        1.0
 19           LU          1     0.1
 20           UD       0.84

 21           KK         42   ROUTE INFLOW HYDROGRAPH THROUGH LAKE KALMIA
 22           RS          1    STOR    77.0
 23           SV          0     77.    64.5    92.8    101.   111.6   122.6   133.9   145.6
 24           SE       402.   410.3   410.7   411.1   411.5    412.   412.5    413.   413.5
 25           SQ         0.      0.     3.3     9.2     98.    648.   1634.   3012.   4707.
 26           SE       402.   410.3   410.7   411.1   411.5    412.   412.5    413.   413.5
 27           SS      410.3     4.3     3.0     1.5
 28           ST      411.1   395.7     0.0     1.5
 29           ZZ
```

```
FLOOD HYDROGRAPH PACKAGE  (HEC-1)                         U.S. ARMY CORPS OF ENGINEERS
       FEBRUARY 1981                                  THE HYDROLOGIC ENGINEERING CENTER
                                                              609 SECOND STREET
RUN DATE08/11/81      TIME16.33.13                          DAVIS, CALIFORNIA 95616
                                                       (916) 440-3285 OR (FTS) 448-3285

                 LAKE KALMIA DAM      OVERTOPPING ANALYSIS      TOM GOOCH   ANCO
                 NEW JERSEY DAM NO. 166 - WARREN COUNTY - BLAIRSTOWN TOWNSHIP
                 150-YEAR STORM (2-HOUR STORM)

 5 IO        OUTPUT CONTROL VARIABLES
                  IPRNT           2  PRINT CONTROL
                  IPLOT           1  PLOT CONTROL
                  QSCAL          0.  HYDROGRAPH PLOT SCALE
                  DMSG          YES  PRINT DIAGNOSTIC MESSAGES

   IT        HYDROGRAPH TIME DATA
                  NMIN            5  MINUTES IN COMPUTATION INTERVAL
                  IDATE      1    0  STARTING DATE
                  ITIME        0000  STARTING TIME
                  NQ            200  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE      1    0  ENDING DATE
                 NDTIME        1635  ENDING TIME

              COMPUTATION INTERVAL    0.08 HOURS
                   TOTAL TIME BASE   16.58 HOURS

         ENGLISH UNITS
              DRAINAGE AREA          SQUARE MILES
              PRECIPITATION DEPTH    INCHES
              LENGTH, ELEVATION      FEET
              FLOW                   CUBIC FEET PER SECOND
              STORAGE VOLUME         ACRE-FEET
              SURFACE AREA           ACRES
              TEMPERATURE            DEGREES FAHRENHEIT

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          *************
          *           *
 6 KK     *     A1    *        LAKE KALMIA INFLOW HYDROGRAPH
          *           *
          *************
                              INFLOW FROM SCS UNIT GRAPH COMPUTATIONS

10 IN        TIME DATA FOR INPUT TIME SERIES
                  JXMIN           5  TIME INTERVAL IN MINUTES
                  JXDATE     1    0  STARTING DATE
                  JXTIME          0  STARTING TIME

            SUBBASIN RUNOFF DATA

 8 EA        SUBBASIN CHARACTERISTICS
                  TAREA        0.50  SUBBASIN AREA

 9 EF        BASE FLOW CHARACTERISTICS
                  STRTQ        1.50  INITIAL FLOW
                  QRCSN        1.50  BEGIN BASE FLOW RECESSION
                  RTIOR     1.00000  RECESSION CONSTANT

             PRECIPITATION DATA

17 PT          TOTAL STORM STATIONS     INFLOW
18 PW                       WEIGHTS       1.00

15 PR           RECORDING STATIONS      INFLOW
16 PW                       WEIGHTS       1.00
```

19 LU UNIFORM LOSS RATE

STRTL	1.00	INITIAL LOSS
CNSTL	0.10	UNIFORM LOSS RATE
RTIMP	0.0	PERCENT IMPERVIOUS AREA

20 UD SCS DIMENSIONLESS UNITGRAPH

TLAG	0.64	LAG

***

PRECIPITATION STATION DATA

STATION	TOTAL	AVG. ANNUAL	WEIGHT
INFLOW	3.73	0.0	1.00

TEMPORAL DISTRIBUTIONS

STATION INFLOW, WEIGHT = 1.00

0.04	0.04	0.05	0.05	0.05	0.06	0.10	0.10	0.14	0.19
0.29	0.53	0.76	0.37	0.22	0.18	0.10	0.10	0.10	0.06
0.05	0.05	0.04	0.04						

UNIT HYDROGRAPH
52 END-OF-PERIOD ORDINATES

8.	25.	48.	78.	117.	164.	206.	242.	263.	273.
273.	266.	250.	231.	209.	162.	152.	125.	108.	92.
79.	69.	59.	51.	43.	37.	32.	27.	24.	20.
17.	15.	13.	11.	9.	8.	7.	5.	5.	4.
4.	3.	3.	2.	2.	2.	2.	1.	1.	1.
0.	0.								

****

HYDROGRAPH AT STATION A1

****

DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q		DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
1		0000	1	0.0	0.0	0.0	2.	*	1		0820	101	0.0	0.0	0.0	2.
1		0005	2	0.04	0.04	0.00	2.	*	1		0825	102	0.0	0.0	0.0	2.
1		0010	3	0.04	0.04	0.00	2.	*	1		0830	103	0.0	0.0	0.0	2.
1		0015	4	0.05	0.05	0.00	2.	*	1		0835	104	0.0	0.0	0.0	2.
1		0020	5	0.05	0.05	0.00	2.	*	1		0840	105	0.0	0.0	0.0	2.
1		0025	6	0.05	0.05	0.00	2.	*	1		0845	106	0.0	0.0	0.0	2.
1		0030	7	0.06	0.06	0.00	2.	*	1		0850	107	0.0	0.0	0.0	2.
1		0035	8	0.10	0.10	0.00	2.	*	1		0855	108	0.0	0.0	0.0	2.
1		0040	9	0.10	0.10	0.00	2.	*	1		0900	109	0.0	0.0	0.0	2.
1		0045	10	0.14	0.14	0.00	2.	*	1		0905	110	0.0	0.0	0.0	2.
1		0050	11	0.19	0.19	0.00	2.	*	1		0910	111	0.0	0.0	0.0	2.
1		0055	12	0.29	0.18	0.11	2.	*	1		0915	112	0.0	0.0	0.0	2.
1		0100	13	0.53	0.01	0.52	8.	*	1		0920	113	0.0	0.0	0.0	2.
1		0105	14	0.76	0.01	0.77	26.	*	1		0925	114	0.0	0.0	0.0	2.
1		0110	15	0.37	0.01	0.36	57.	*	1		0930	115	0.0	0.0	0.0	2.
1		0115	16	0.22	0.01	0.21	102.	*	1		0935	116	0.0	0.0	0.0	2.
1		0120	17	0.18	0.01	0.17	164.	*	1		0940	117	0.0	0.0	0.0	2.
1		0125	18	0.10	0.01	0.09	243.	*	1		0945	118	0.0	0.0	0.0	2.
1		0130	19	0.10	0.01	0.09	332.	*	1		0950	119	0.0	0.0	0.0	2.
1		0135	20	0.10	0.01	0.09	421.	*	1		0955	120	0.0	0.0	0.0	2.
1		0140	21	0.06	0.01	0.05	499.	*	1		1000	121	0.0	0.0	0.0	2.
1		0145	22	0.05	0.01	0.04	560.	*	1		1005	122	0.0	0.0	0.0	2.
1		0150	23	0.05	0.01	0.04	602.	*	1		1010	123	0.0	0.0	0.0	2.
1		0155	24	0.04	0.01	0.03	625.	*	1		1015	124	0.0	0.0	0.0	2.
1		0200	25	0.04	0.01	0.03	632.	*	1		1020	125	0.0	0.0	0.0	2.
1		0205	26	0.0	0.0	0.0	622.	*	1		1025	126	0.0	0.0	0.0	2.
1		0210	27	0.0	0.0	0.0	599.	*	1		1030	127	0.0	0.0	0.0	2.
1		0215	28	0.0	0.0	0.0	559.	*	1		1035	128	0.0	0.0	0.0	2.
1		0220	29	0.0	0.0	0.0	513.	*	1		1040	129	0.0	0.0	0.0	2.
1		0225	30	0.0	0.0	0.0	465.	*	1		1045	130	0.0	0.0	0.0	2.

1	0230	31	0.0	0.0	0.0	413.	*	1	1050	131	0.0	0.0	0.0	2.
1	0235	32	0.0	0.0	0.0	366.	*	1	1055	132	0.0	0.0	0.0	2.
1	0240	33	0.0	0.0	0.0	322.	*	1	1100	133	0.0	0.0	0.0	2.
1	0245	34	0.0	0.0	0.0	283.	*	1	1105	134	0.0	0.0	0.0	2.
1	0250	35	0.0	0.0	0.0	249.	*	1	1110	135	0.0	0.0	0.0	2.
1	0255	36	0.0	0.0	0.0	215.	*	1	1115	136	0.0	0.0	0.0	2.
1	0300	37	0.0	0.0	0.0	186.	*	1	1120	137	0.0	0.0	0.0	2.
1	0305	38	0.0	0.0	0.0	151.	*	1	1125	138	0.0	0.0	0.0	2.
1	0310	39	0.0	0.0	0.0	135.	*	1	1130	139	0.0	0.0	0.0	2.
1	0315	40	0.0	0.0	0.0	118.	*	1	1135	140	0.0	0.0	0.0	2.
1	0320	41	0.0	0.0	0.0	102.	*	1	1140	141	0.0	0.0	0.0	2.
1	0325	42	0.0	0.0	0.0	87.	*	1	1145	142	0.0	0.0	0.0	2.
1	0330	43	0.0	0.0	0.0	75.	*	1	1150	143	0.0	0.0	0.0	2.
1	0335	44	0.0	0.0	0.0	64.	*	1	1155	144	0.0	0.0	0.0	2.
1	0340	45	0.0	0.0	0.0	55.	*	1	1200	145	0.0	0.0	0.0	2.
1	0345	46	0.0	0.0	0.0	48.	*	1	1205	146	0.0	0.0	0.0	2.
1	0350	47	0.0	0.0	0.0	41.	*	1	1210	147	0.0	0.0	0.0	2.
1	0355	48	0.0	0.0	0.0	36.	*	1	1215	148	0.0	0.0	0.0	2.
1	0400	49	0.0	0.0	0.0	31.	*	1	1220	149	0.0	0.0	0.0	2.
1	0405	50	0.0	0.0	0.0	27.	*	1	1225	150	0.0	0.0	0.0	2.
1	0410	51	0.0	0.0	0.0	23.	*	1	1230	151	0.0	0.0	0.0	2.
1	0415	52	0.0	0.0	0.0	20.	*	1	1235	152	0.0	0.0	0.0	2.
1	0420	53	0.0	0.0	0.0	17.	*	1	1240	153	0.0	0.0	0.0	2.
1	0425	54	0.0	0.0	0.0	15.	*	1	1245	154	0.0	0.0	0.0	2.
1	0430	55	0.0	0.0	0.0	13.	*	1	1250	155	0.0	0.0	0.0	2.
1	0435	56	0.0	0.0	0.0	12.	*	1	1255	156	0.0	0.0	0.0	2.
1	0440	57	0.0	0.0	0.0	10.	*	1	1300	157	0.0	0.0	0.0	2.
1	0445	58	0.0	0.0	0.0	9.	*	1	1305	158	0.0	0.0	0.0	2.
1	0450	59	0.0	0.0	0.0	8.	*	1	1310	159	0.0	0.0	0.0	2.
1	0455	60	0.0	0.0	0.0	7.	*	1	1315	160	0.0	0.0	0.0	2.
1	0500	61	0.0	0.0	0.0	6.	*	1	1320	161	0.0	0.0	0.0	2.
1	0505	62	0.0	0.0	0.0	5.	*	1	1325	162	0.0	0.0	0.0	2.
1	0510	63	0.0	0.0	0.0	5.	*	1	1330	163	0.0	0.0	0.0	2.
1	0515	64	0.0	0.0	0.0	4.	*	1	1335	164	0.0	0.0	0.0	2.
1	0520	65	0.0	0.0	0.0	3.	*	1	1340	165	0.0	0.0	0.0	2.
1	0525	66	0.0	0.0	0.0	3.	*	1	1345	166	0.0	0.0	0.0	2.
1	0530	67	0.0	0.0	0.0	2.	*	1	1350	167	0.0	0.0	0.0	2.
1	0535	68	0.0	0.0	0.0	2.	*	1	1355	168	0.0	0.0	0.0	2.
1	0540	69	0.0	0.0	0.0	2.	*	1	1400	169	0.0	0.0	0.0	2.
1	0545	70	0.0	0.0	0.0	2.	*	1	1405	170	0.0	0.0	0.0	2.
1	0550	71	0.0	0.0	0.0	2.	*	1	1410	171	0.0	0.0	0.0	2.
1	0555	72	0.0	0.0	0.0	2.	*	1	1415	172	0.0	0.0	0.0	2.
1	0600	73	0.0	0.0	0.0	2.	*	1	1420	173	0.0	0.0	0.0	2.
1	0605	74	0.0	0.0	0.0	2.	*	1	1425	174	0.0	0.0	0.0	2.
1	0610	75	0.0	0.0	0.0	2.	*	1	1430	175	0.0	0.0	0.0	2.
1	0615	76	0.0	0.0	0.0	2.	*	1	1435	176	0.0	0.0	0.0	2.
1	0620	77	0.0	0.0	0.0	2.	*	1	1440	177	0.0	0.0	0.0	2.
1	0625	78	0.0	0.0	0.0	2.	*	1	1445	178	0.0	0.0	0.0	2.
1	0630	79	0.0	0.0	0.0	2.	*	1	1450	179	0.0	0.0	0.0	2.
1	0635	80	0.0	0.0	0.0	2.	*	1	1455	180	0.0	0.0	0.0	2.
1	0640	81	0.0	0.0	0.0	2.	*	1	1500	181	0.0	0.0	0.0	2.
1	0645	82	0.0	0.0	0.0	2.	*	1	1505	182	0.0	0.0	0.0	2.
1	0650	83	0.0	0.0	0.0	2.	*	1	1510	183	0.0	0.0	0.0	2.
1	0655	84	0.0	0.0	0.0	2.	*	1	1515	184	0.0	0.0	0.0	2.
1	0700	85	0.0	0.0	0.0	2.	*	1	1520	185	0.0	0.0	0.0	2.
1	0705	86	0.0	0.0	0.0	2.	*	1	1525	186	0.0	0.0	0.0	2.
1	0710	87	0.0	0.0	0.0	2.	*	1	1530	187	0.0	0.0	0.0	2.
1	0715	88	0.0	0.0	0.0	2.	*	1	1535	188	0.0	0.0	0.0	2.
1	0720	89	0.0	0.0	0.0	2.	*	1	1540	189	0.0	0.0	0.0	2.
1	0725	90	0.0	0.0	0.0	2.	*	1	1545	190	0.0	0.0	0.0	2.
1	0730	91	0.0	0.0	0.0	2.	*	1	1550	191	0.0	0.0	0.0	2.
1	0735	92	0.0	0.0	0.0	2.	*	1	1555	192	0.0	0.0	0.0	2.
1	0740	93	0.0	0.0	0.0	2.	*	1	1600	193	0.0	0.0	0.0	2.
1	0745	94	0.0	0.0	0.0	2.	*	1	1605	194	0.0	0.0	0.0	2.
1	0750	95	0.0	0.0	0.0	2.	*	1	1610	195	0.0	0.0	0.0	2.
1	0755	96	0.0	0.0	0.0	2.	*	1	1615	196	0.0	0.0	0.0	2.
1	0800	97	0.0	0.0	0.0	2.	*	1	1620	197	0.0	0.0	0.0	2.
1	0805	98	0.0	0.0	0.0	2.	*	1	1625	198	0.0	0.0	0.0	2.
1	0810	99	0.0	0.0	0.0	2.	*	1	1630	199	0.0	0.0	0.0	2.
1	0815	100	0.0	0.0	0.0	2.	*	1	1635	200	0.0	0.0	0.0	2.
							*			SUM	3.73	1.11	2.62	

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  PEAK FLOW     TIME                                   MAXIMUM AVERAGE FLOW
    (CFS)       (HR)                        6-HR          24-HR        72-HR       16.58-HR
     652.       2.00            (CFS)       142.           52.          52.           52.
                             (INCHES)      2.545         2.696        2.696         2.696
                              (AC-FT)        71.           72.          72.           72.

                                CUMULATIVE AREA =     0.50 SQ MI

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            *            *
 21 KK      *      A2    *        ROUTE INFLOW HYDROGRAPH THROUGH LAKE KALMIA
            *            *
            **************

              HYDROGRAPH ROUTING DATA

 22 RS           STORAGE ROUTING
                      NSTPS              1   NUMBER OF SUBREACHES
                       ITYP           STOR   TYPE OF INITIAL CONDITION
                     RSVRIC          77.00   INITIAL CONDITION
                          X            0.0   WORKING R AND D COEFFICIENT

 23 SV            STORAGE        0.0      77.0      84.8      92.8     101.0     111.6     122.6     133.9     145.6
 24 SE          ELEVATION     402.00    410.30    410.70    411.10    411.50    412.00    412.50    413.00    413.50
 25 SQ          DISCHARGE         0.        0.        3.        9.       98.      648.     1634.     3012.     4707.
 26 SE          ELEVATION     402.00    410.30    410.70    411.10    411.50    412.00    412.50    413.00    413.50

 27 SS           SPILLWAY
                       CREL     410.30   SPILLWAY CREST ELEVATION
                      SPWID       4.30   SPILLWAY WIDTH
                       COQW       3.00   WEIR COEFFICIENT
                       EXPW       1.50   EXPONENT OF HEAD

 28 ST           TOP OF DAM
                      TOPEL     411.10   ELEVATION AT TOP OF DAM
                     DAMWID     395.70   DAM WIDTH
                       COQD        0.0   WEIR COEFFICIENT
                       EXPD       1.50   EXPONENT OF HEAD

                                                             ***

                                                 COMPUTED STORAGE-OUTFLOW CURVE
          STORAGE         0.0       77.00      84.80      92.80     101.00     111.60     122.60     133.90     145.60
          OUTFLOW         0.0        0.0        3.30       9.20      98.00     648.00    1634.00    3012.00    4707.00
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HYDROGRAPH AT STATION A2

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	77.0	410.3	1		0535	68	26.	94.3	411.2	1		1110	135	7.	90.4	411.0
1		0005	2	0.	77.0	410.3	1		0540	69	24.	94.2	411.2	1		1115	136	7.	90.4	411.0
1		0010	3	0.	77.0	410.3	1		0545	70	22.	94.0	411.2	1		1120	137	7.	90.3	411.0
1		0015	4	0.	77.0	410.3	1		0550	71	21.	93.9	411.2	1		1125	138	7.	90.3	411.0
1		0020	5	0.	77.0	410.3	1		0555	72	20.	93.8	411.1	1		1130	139	7.	90.3	411.0
1		0025	6	0.	77.0	410.3	1		0600	73	19.	93.6	411.1	1		1135	140	7.	90.2	411.0
1		0030	7	0.	77.1	410.3	1		0605	74	17.	93.5	411.1	1		1140	141	7.	90.2	411.0
1		0035	8	0.	77.1	410.3	1		0610	75	15.	93.4	411.1	1		1145	142	7.	90.1	411.0
1		0040	9	0.	77.1	410.3	1		0615	76	15.	93.3	411.1	1		1150	143	7.	90.1	411.0
1		0045	10	0.	77.1	410.3	1		0620	77	14.	93.2	411.1	1		1155	144	7.	90.1	411.0
1		0050	11	0.	77.1	410.3	1		0625	78	13.	93.2	411.1	1		1200	145	7.	90.0	411.0
1		0055	12	0.	77.1	410.3	1		0630	79	12.	93.1	411.1	1		1205	146	7.	90.0	411.0
1		0100	13	0.	77.1	410.3	1		0635	80	12.	93.0	411.1	1		1210	147	7.	90.0	411.0
1		0105	14	0.	77.3	410.3	1		0640	81	11.	93.0	411.1	1		1215	148	7.	89.9	411.0
1		0110	15	0.	77.5	410.3	1		0645	82	10.	92.9	411.1	1		1220	149	7.	89.9	411.0
1		0115	16	0.	78.1	410.4	1		0650	83	10.	92.8	411.1	1		1225	150	7.	89.8	411.0
1		0120	17	1.	79.0	410.4	1		0655	84	9.	92.8	411.1	1		1230	151	7.	89.8	410.9
1		0125	18	1.	80.4	410.5	1		0700	85	9.	92.7	411.1	1		1235	152	7.	89.8	410.9
1		0130	19	2.	82.3	410.5	1		0705	86	9.	92.7	411.1	1		1240	153	7.	89.7	410.9
1		0135	20	3.	84.9	410.7	1		0710	87	9.	92.6	411.1	1		1245	154	7.	89.7	410.9
1		0140	21	6.	88.1	410.9	1		0715	88	9.	92.6	411.1	1		1250	155	7.	89.6	410.9
1		0145	22	5.	91.5	411.0	1		0720	89	9.	92.5	411.1	1		1255	156	7.	89.6	410.9
1		0150	23	36.	95.5	411.2	1		0725	90	9.	92.5	411.1	1		1300	157	7.	89.6	410.9
1		0155	24	56.	99.3	411.4	1		0730	91	9.	92.4	411.1	1		1305	158	7.	89.5	410.9
1		0200	25	167.	102.7	411.5	1		0735	92	9.	92.4	411.1	1		1310	159	7.	89.5	410.9
1		0205	26	320.	105.3	411.7	1		0740	93	9.	92.3	411.1	1		1315	160	7.	89.4	410.9
1		0210	27	406.	107.0	411.8	1		0745	94	9.	92.3	411.1	1		1320	161	7.	89.4	410.9
1		0215	28	461.	108.0	411.8	1		0750	95	9.	92.2	411.1	1		1325	162	7.	89.4	410.9
1		0220	29	465.	108.5	411.9	1		0755	96	9.	92.2	411.1	1		1330	163	7.	89.3	410.9
1		0225	30	487.	109.5	411.9	1		0800	97	9.	92.1	411.1	1		1335	164	7.	89.3	410.9
1		0230	31	477.	109.2	411.9	1		0805	98	9.	92.1	411.1	1		1340	165	7.	89.3	410.9
1		0235	32	447.	107.7	411.9	1		0810	99	9.	92.0	411.1	1		1345	166	7.	89.2	410.9
1		0240	33	415.	107.1	411.8	1		0815	100	9.	92.0	411.1	1		1350	167	7.	89.2	410.9
1		0245	34	381.	106.5	411.8	1		0820	101	9.	91.9	411.1	1		1355	168	7.	89.2	410.9
1		0250	35	346.	105.8	411.7	1		0825	102	9.	91.9	411.1	1		1400	169	6.	89.1	410.9
1		0255	36	311.	105.1	411.7	1		0830	103	8.	91.8	411.1	1		1405	170	6.	89.1	410.9
1		0300	37	277.	104.5	411.7	1		0835	104	8.	91.8	411.0	1		1410	171	6.	89.1	410.9
1		0305	38	246.	103.8	411.6	1		0840	105	8.	91.7	411.0	1		1415	172	6.	89.0	410.9
1		0310	39	216.	103.3	411.6	1		0845	106	8.	91.7	411.0	1		1420	173	6.	89.0	410.9
1		0315	40	190.	102.8	411.6	1		0850	107	8.	91.6	411.0	1		1425	174	6.	89.0	410.9
1		0320	41	165.	102.3	411.5	1		0855	108	8.	91.6	411.0	1		1430	175	6.	88.9	410.9
1		0325	42	144.	101.9	411.5	1		0900	109	8.	91.6	411.0	1		1435	176	6.	88.9	410.9
1		0330	43	125.	101.5	411.5	1		0905	110	8.	91.5	411.0	1		1440	177	6.	88.9	410.9
1		0335	44	108.	101.2	411.5	1		0910	111	8.	91.5	411.0	1		1445	178	6.	88.8	410.9
1		0340	45	97.	100.9	411.5	1		0915	112	8.	91.4	411.0	1		1450	179	6.	88.8	410.9
1		0345	46	94.	100.6	411.5	1		0920	113	8.	91.4	411.0	1		1455	180	6.	88.8	410.9
1		0350	47	90.	100.3	411.5	1		0925	114	8.	91.3	411.0	1		1500	181	6.	88.7	410.9
1		0355	48	85.	99.9	411.4	1		0930	115	8.	91.3	411.0	1		1505	182	6.	88.7	410.9
1		0400	49	82.	99.5	411.4	1		0935	116	8.	91.3	411.0	1		1510	183	6.	88.7	410.9
1		0405	50	79.	99.2	411.4	1		0940	117	8.	91.2	411.0	1		1515	184	6.	88.6	410.9
1		0410	51	75.	98.8	411.4	1		0945	118	8.	91.2	411.0	1		1520	185	6.	88.6	410.9
1		0415	52	71.	98.5	411.4	1		0950	119	8.	91.1	411.0	1		1525	186	6.	88.6	410.9
1		0420	53	67.	98.1	411.4	1		0955	120	8.	91.1	411.0	1		1530	187	6.	88.5	410.9
1		0425	54	63.	97.8	411.3	1		1000	121	8.	91.0	411.0	1		1535	188	6.	88.5	410.9
1		0430	55	60.	97.5	411.3	1		1005	122	8.	91.0	411.0	1		1540	189	6.	88.5	410.9
1		0435	56	56.	97.2	411.3	1		1010	123	8.	90.9	411.0	1		1545	190	6.	88.4	410.9
1		0440	57	53.	96.9	411.3	1		1015	124	8.	90.9	411.0	1		1550	191	6.	88.4	410.9
1		0445	58	50.	96.6	411.3	1		1020	125	8.	90.9	411.0	1		1555	192	6.	88.4	410.9
1		0450	59	47.	96.3	411.3	1		1025	126	8.	90.8	411.0	1		1600	193	6.	88.3	410.9
1		0455	60	44.	96.0	411.3	1		1030	127	8.	90.8	411.0	1		1605	194	6.	88.3	410.9
1		0500	61	41.	95.8	411.2	1		1035	128	8.	90.7	411.0	1		1610	195	6.	88.3	410.9
1		0505	62	39.	95.5	411.2	1		1040	129	8.	90.7	411.0	1		1615	196	6.	88.2	410.9
1		0510	63	36.	95.3	411.2	1		1045	130	8.	90.6	411.0	1		1620	197	6.	88.2	410.9
1		0515	64	34.	95.1	411.2	1		1050	131	8.	90.6	411.0	1		1625	198	6.	88.2	410.9
1		0520	65	32.	94.9	411.2	1		1055	132	8.	90.5	411.0	1		1630	199	6.	88.1	410.9
1		0525	66	30.	94.7	411.2	1		1100	133	8.	90.5	411.0	1		1635	200	6.	88.1	410.9
1		0530	67	28.	94.5	411.2	1		1105	134	7.	90.5	411.0							

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PEAK OUTFLOW IS      487. AT TIME   2.42 HOURS

PEAK FLOW      TIME                                  MAXIMUM AVERAGE FLOW
  (CFS)        (HR)                     6-HR         24-HR         72-HR       15.58-HR
   487.        2.42          (CFS)      111.           44.           44.            44.
                           (INCHES)    2.071         2.272         2.272          2.272
                            (AC-FT)      55.           61.           61.            61.

PEAK STORAGE   TIME                                  MAXIMUM AVERAGE STORAGE
  (AC-FT)      (HR)                     6-HR         24-HR         72-HR       15.58-HR
    108.       2.42                      96.           92.           92.            92.

PEAK STAGE     TIME                                  MAXIMUM AVERAGE STAGE
  (FEET)       (HR)                     6-HR         24-HR         72-HR       16.58-HR
  411.85       2.42                   411.34        411.03        411.03         411.03

                        CUMULATIVE AREA =     0.50 SQ MI
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RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH A1	A1	632.	2.00	142.	52.	52.	0.50		
ROUTED TO	A2	437.	2.42	111.	44.	44.	0.50	411.85	2.42

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION A2

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	410.30	410.30	411.10
STORAGE	77.	77.	93.
OUTFLOW	0.	0.	9.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	411.85	0.75	108.	487.	5.08	2.42	0.0

*** NORMAL END OF JOB ***

APPENDIX 6

REFERENCES

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LAKE KALMIA DAM

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